

Effective Transmission Planning Practices for California's Renewable Resources

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Executive Summary:

The aggressive policies and programs instituted at all levels of public and private institutions in California to reduce Greenhouse Gas (GHG) emissions can be readily rendered ineffective if transmission planning for renewable resources is not properly and effectively practiced. Most federal and state laws, policies and tariffs on transmission planning do promote liberal transmission access for renewable resources. However, to be effective, such laws, policies and tariffs must be complemented by actual business and engineering practices that realize their goal. Unfortunately, due to the very complex nature of the transmission planning process and policies, such an effective connection between clean energy policies and transmission planning policies and practice is not always straightforward to implement.

This white paper offers a set of wide-ranging, yet high level, recommendations on effective practices for transmission planning for California's renewable resources particularly those who would interconnect to the CAISO controlled grid. We will use the term "Resource Interconnection Studies" to more specifically refer to this category of transmission planning. We believe that these recommended practices, while completely consistent with the existing state and federal laws, policies and tariffs, will go a long way to better facilitate the interconnection of renewable resources in a technically sound fashion. Our recommendations are as follows:

1. Resource interconnection studies should fully account for the relevant provisions of the California Independent System Operators (CAISO's) new electricity market under Market Redesign and Technology Upgrade (MRTU);
2. Resource interconnection studies should systematically use the clustered study provision of the CAISO's Large Generation Interconnection Protocol (LGIP) to perform generation interconnection studies for all interconnecting resource requests;
3. Resource interconnection studies should use innovative and effective clustering practices, including retroactive clustering similar to what was used for the Tehachapi Transmission Project, to clear the exiting queues for interconnection requests;
4. Resource interconnection studies should account for the diversity in generation output pattern of the new interconnecting resources in a cluster vis-à-vis one another as well as vis-à-vis existing resources within and in the electrical vicinity of that cluster;
5. CAISO should work with the federal and state regulators and the Participating Transmission Owners (PTOs) to allow network upgrades for clustered generation to be directly rate-based in TAC; and

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6. Resource interconnection studies should, to the extent possible, be synchronized and, if possible, combined with CAISO's and its Participating Transmission Owners' (PTOs') annual transmission planning process.

Based on the recommendations enumerated above, a very clear and critical conclusion of this paper is that the California Independent System Operator (CAISO) should play a significantly more prominent role in developing, overseeing and performing the underlying technical solutions and practices that are used for resource interconnection studies.

Background:

Many federal and state institutions involved in the electric utility industry in California have been instituting laws, policies, tariffs, and business protocols in a very rapid pace to encourage the rapid expansion of renewable resources for meeting the state's electrical power demand. Some of the noteworthy initiatives include:

- California State Law SB 1078 instituting the state's Renewable Portfolio Standard (RPS);
- California State Law AB32 setting hard limit on GHG emission for generators used to meet the California electric power demand;
- California Public Utilities Commission's (CPUC's) and California Energy Commission's (CEC's) initiatives and mandates to accelerate the implementation of State's RPS program;
- CAISO's policy initiative on "Multi-User Trunk Lines" and FERC approval of the Multi-User Trunk Lines concept; and
- CAISO's study and approval of the Tehachapi Transmission Project

However, all the good intentions of such initiatives can be lost if access to transmission for renewable resources is limited due to dated methods and practices used by the responsible agencies who perform resource interconnection studies. In this report, we will broadly identify those areas where interconnection study methods and practices need to be seriously re-evaluated and potentially modified. We also provide recommendations for the changes in such methods and practices in order to better facilitate the interconnection of California's renewable resources.

Existing Generation Interconnection Study Process

Table 1, below, broadly outlines the general steps involved in performing interconnection studies under the CAISO's current Large Generation Interconnection Protocol or LGIP. This table includes the responsibilities of various parties involved in the interconnection studies and the expected outcome of each step. As it is evident from Table 1, the entire process of interconnection studies is mainly focused on identifying the transmission facilities (and their costs) needed to reliably interconnect a new resource to the CAISO controlled transmission system. The final outcome of the process is a three way agreement, called the Large Generation Interconnection Agreement (LGIA), that is signed by the CAISO, the Interconnection Customer (IC) and the impacted PTO which grants access to transmission to the IC and stipulates the condition for such access including various cost responsibilities and the obligation of the three parties.

Table 1: Broad LGIP Process for Generation Interconnection Studies

LGIP Step	Interconnection Customer (IC) Responsibilities	CAISO Responsibilities	Evaluator (normally PTO) Responsibility	Expected Outcome
Interconnection Request (IR)	<ul style="list-style-type: none"> • Submit IR including a number of potential interconnection points plus the request (deposit) for the Feasibility Study (FS) • Participate in the Scoping Meeting (SM) • Offer opinion on the Evaluator and study approach/assumptions 	<ul style="list-style-type: none"> • Assign internal transmission study engineer and select an external Evaluator (normally the PTO), if necessary • Set up SM with the IC and the Evaluator • Suggest alternative points for resource interconnection • Finalize study assumptions and methodology 	<ul style="list-style-type: none"> • Participate in the initial meeting and offer opinion on Evaluator and study approach and assumptions 	Selected Evaluator, study methodology/assumptions
Feasibility Study (FS)	<ul style="list-style-type: none"> • Review the FS and make comments • Submit request (deposit) for SIS, if applicable 	<ul style="list-style-type: none"> • Review the FS and comments by IC and finalize 	<ul style="list-style-type: none"> • Perform FS 	Rough estimate of the required transmission facilities and costs required for the IR
System Impact Study (SIS)	<ul style="list-style-type: none"> • Review the SIS and make comments • Submit request (deposit) for FAS, if applicable 	<ul style="list-style-type: none"> • Review the SIS and comments by IC and finalize 	<ul style="list-style-type: none"> • Perform SiS 	Estimate of the required transmission facilities and associated costs: +/-50%
Facilities Study (FAS)	<ul style="list-style-type: none"> • Review the FAS and make comments 	<ul style="list-style-type: none"> • Review the FAS and comments by IC and finalize 	<ul style="list-style-type: none"> • Perform FAS 	Good estimate of the required transmission facilities and associated costs: +/-20% Main terms/conditions of interconnection agreement
Large Generation Interconnection Agreement (LGIA)	<ul style="list-style-type: none"> • Negotiate the terms of the 3-way LGIA 	<ul style="list-style-type: none"> • Negotiate the terms of the 3-way LGIA 	<ul style="list-style-type: none"> • Negotiate the terms of the 3-way LGIA 	Finalized and specific transmission costs and responsibilities

Table 2, further below, categorizes the transmission facilities identified as part of the LGIP process and some of the underlying approaches to calculate them. It is important that the reader thoroughly understand the concept and the content of Table 2 in order fully follow the principal argument and the recommendations of this paper.

Table 2: Transmission Facilities Category for Generation Interconnection

Transmission Category	Typical Transmission Upgrades	Initial Cost Responsibility	Final Cost Responsibility ^a
Interconnection Facilities: Interconnect the resource to the transmission grid	<ul style="list-style-type: none"> • Generator Substation • Transmission line(s) connecting generator substation to the transmission system • Breakers in the connecting transmission lines above 	IC	IC
Reliability Network Upgrades: Network transmission upgrades/additions necessary for reliable operation of the system under contingency scenarios.	<ul style="list-style-type: none"> • Breaker or substation grounding upgrades necessary at any transmission substation • SPS^c necessary to address those credible contingency scenarios that are not modeled in MRTU IFM/SCUC model^d 	IC	TAC ^b
Delivery Network Upgrades: Network transmission upgrades/additions necessary for reliable operation of the system when the interconnecting generator operates at its nameplate rating.	<ul style="list-style-type: none"> • Least cost "local" network transmission upgrades or SPS necessary to deal with normal and credible contingency scenarios stressing the "local" transmission system 	IC	TAC
System-wide Deliverability Upgrade: Network transmission upgrades/additions necessary for reliable operation of the system when the interconnecting generator operates at its nameplate (or maximum allowed) rating.	<ul style="list-style-type: none"> • Least cost network transmission upgrades or SPS anywhere in the transmission system necessary to deal with normal and credible contingency scenarios at the time of system peak condition (summer peak load condition) 	IC	TAC

^a Local system refers to the transmission grid in the general vicinity of generation interconnection

^b Transmission developer, normally the PTO, refunds the IC after the generation unit goes into operation (refund can be made over a 5 year period) and then recovers the fees through the CAISO Transmission Access Charge (TAC). Alternatively, PTO can elect to up front fund.

^c The Special Protection Scheme (SPS) should be within the CAISO guidelines. It is likely that if SPS does not fall within the guideline at full generator rating, that it will fall within at a lower output level which should constitute the maximum allowed output of the resource. It is possible to search for and identify least cost network upgrades that may be combined with the SPS to make the SPS fall within the CAISO guidelines. Finally, the CAISO guidelines for SPS may need a serious stakeholder review and discussion.

^d IFM/SCUC (Integrated Forward Market's Security Constrained Unit Commitment) refers to the model used to solve for the optimum commitment and scheduling of all resources of the Day Ahead (DA) market while accounting for a set of pre-specified contingencies.

While the overall LGIP process for performing interconnection studies and granting transmission access is sound, there are a few key practices that are commonly used in performing these studies (and in granting transmission access) that can raise unnecessary barriers to the deployment of renewable resources in California due to transmission access issues. In the following we identify each one of these practices and offer recommendations to rectify them. We want to again emphasize that all our recommendations are completely consistent with existing laws, policies and tariffs.

Interconnection Study Based on CAISO's Current Zonal DA Market Operation:

Due to its extensive and adverse experience with the operation its current zonal Day Ahead (DA) market that manages the transmission congestion only on major zonal ties, the CAISO instituted the "No New Congestion" rule for new resource interconnections. This rule implied that the Delivery Network Upgrade (DNU) for an interconnecting generator must be completed before the generator could be brought online. This rule was instituted to address the reliability and ratepayer cost exposures for those new generators who were scheduled to generate as part of the CAISO current zonal DA market but had to be dispatched down for numerous hours as part of the later performed intra-zonal congestion management and/or Real-Time market. Based on this properly constructed logic, the CAISO and PTOs have systematically denied access to the transmission system prior to Delivery Network Upgrades going online.

However, the CAISO's new market construct (MRTU: Market Redesign and Technology Upgrade), accounts for congestion on all transmission facilities modeled in its Integrated Forward Market's (IFM's) network model. Hence, except under extra-ordinary operating scenarios, no post DA re-scheduling/redispach of scheduled would be required to deal with full transmission constraints. This fact obviates the justification for the No New Congestion rule and for denying transmission access to new resources prior to the availability of the Delivery Network Upgrades. It must, however, be noted that under these circumstances the Interconnection Customer must understand that the output of its resource will be subject to congestion management by the CAISO and that full nameplate rating of the resource may not be deemed deliverable³ until the identified NDU is in place.

Recommendation 1: CAISO should account for market/system operations protocols under MRTU when performing generation interconnection studies and to offer the option of "congestion management" as a viable condition for granting transmission access to Interconnection Customers. Under such a scenario, the choice of accepting such an interconnection condition along with its commensurate limitations, such as limited Resource Adequacy (RA) payments, will become solely the responsibility of the Interconnection Customer.⁴

We believe that this recommendation will go a long way to facilitate the interconnection of all resources in general, and renewable resources in particular, especially during the timeframe when Network Delivery Upgrades are not still completed. Nowhere is this condition more relevant than in the case of the Tehachapi Wind Resource Area (TWRA) where the timeline

³ Further deliverability limitations may be placed on the unit output based on the requirement of System-wide Deliverability Upgrades. Deliverability limitation will also limit the eligibility for Resource Adequacy payment for a resource.

⁴ This recommendation is completely compatible with the current FERC orders and the CAISO tariffs and business protocols. It should also be noted that all new interconnection studies are for resources that intend to come online post MRTU implementation.

for implementation of the Network Delivery Upgrades (and especially that of Substation 5) is severely delaying the deployment wind resources due to transmission access issues.

Resource by Resource Interconnection Studies:

Although CAISO's LGIP tariff allows for clustered interconnection studies, the CAISO and its PTOs have rarely used the clustered study provision. One exception has been the Tehachapi Transmission Project. At the same time the FERC, RTOs and ISOs, PTOs and the Interconnection Customers almost unanimously agree that clustered interconnection studies result in faster, higher quality, lower cost, and better fit transmission solutions for interconnecting new resources and a lower cost of performing the studies.

Recommendation 2: CAISO should develop and systematically use clustered interconnection study approaches for resources generally located in the same geographic (electrical) area.

We believe that implementation of this provision will play a significant role in facilitating the interconnection of renewable resources as such resources are normally bunched together in the same specific geographic areas; some are near major network facilities and some are far from the existing transmission infrastructures in California, but are important to policies and goals.

Recommendation 3: CAISO should also consider using special clustered interconnection study solutions, such as the one used the Tehachapi Transmission Project, for clearing the existing cluttered interconnection queues.

Ignoring Resource Diversity

When performing generation interconnection studies it is common to consider the generation dispatch that most stresses the local network facilities. This approach, while very appropriate for thermal resources that could be dispatched at any level at anytime, should be revisited for renewable resources to account for the probability of certain dispatches from ever occurring. For example, wind resources in specific geographic areas will probably never be operating at their nameplate rating, due to availability of wind, during local or system-wide peak load conditions. Hence, under these circumstances, the suitable operating scenario to be studied should not be one where the load, most existing thermal resources and the interconnecting resources are all operating at full rating.

The interconnection studies should also account for the diversity of the output of interconnecting resources within a cluster using the same principal presented above, i.e., a reasonable dispatch of resources within a cluster should be used for interconnection studies rather than one that simply considers that all interconnecting generator within a cluster are at full rating. Furthermore, clustered interconnection studies should consider the probability of some of the resources within a cluster may not materialize.

Recommendation 4: CAISO should account for diversity of the output of interconnecting resources vis-à-vis one another as well as those existing system resources when performing its interconnection studies.

We believe that implementation of this provision will play a significant role in managing the extent and cost of network upgrades for renewable resources (and potentially obviate the need for much of the upgrades considered today) and hence facilitating earlier interconnection of renewable resources.

While clustered interconnection studies offer numerous benefits, they introduce the challenge of allocating the cost of Network Upgrades (reliability or delivery upgrades) among interconnection customers. Considering that expenses for all such upgrades will be eventually rate-based in the TAC unless the resource project is abandoned, and considering our recommendation to properly account for the diversity of generation in the cluster, we believe that the risk of network upgrades becoming "stranded" will be minimal.

Recommendation 5: CAISO should work with PTOs and federal and state regulators to allow direct TAC rate-basing of network upgrades of all types for interconnecting resources studied as part of a cluster. CAISO should work with PTOs and CPUC to allow backstop funding of cluster studies, early permitting work, and large scale common facilities planning associated with clustering and clustered studies.

We believe that implementation of this provision will have a significant positive impact on timely deployment of network upgrades; hence, better facilitating interconnection of renewable resources.

Disjoint Bulk System Planning and Resource Interconnection Studies

There have been little, if any, coordination between annual system planning practices and resource interconnection studies. A better coordination between these two processes will not only result in more cost effective transmission upgrades, better scaled, and also should help with cost allocation principles and clustering presented earlier.

Recommendation 6: Resource interconnection studies should, to the extent possible, be synchronized and, if possible, combined with CAISO's and its Participating Transmission Owners' (PTOs') annual transmission planning process.

Similar to that of Recommendation 5, we believe that implementation of this coordination will have a significant positive impact on timely deployment of network upgrades; hence, better facilitating interconnection of renewable resources, and earlier deliverability to load.

Concluding Remarks:

Adoption of the recommendations of this white paper will go a long way to better facilitate interconnection of renewable resources and to help California meet its RPS goals. We believe that the CAISO is the key entity to effectively implement these recommendations and hence we strongly urge the CAISO to play a much bigger and more direct role in managing the process and performing the actual resource interconnection studies.