The Western EIM's Approach To Applying California's Cap and Trade Program To Imports Is Undermining The Program's Core Objectives

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Overview

Several U.S. states have implemented and/or are developing programs to reduce GHG emissions across many if not all sectors of the economy. In the electricity sector, this includes not only resource procurement programs, such as state-level renewable portfolio standards (RPSs) and clean energy standards (CESs), but also GHG-pricing programs. In the western U.S., the two most advanced GHG-pricing programs are California's Cap-and-Trade Program, which has been in operation since 2013, and Washington's similar Cap-and-Invest Program, which will launch in 2023.

The key objective of these GHG-pricing programs, with respect to the wholesale electricity sector, is to drive a reduction in the use of GHG-emitting resources by:

1. Incorporating the cost of GHG emissions into the wholesale price of electricity to ***provide accurate price signals,*** raising wholesale electricity prices when GHG emitting resources are the marginal resources supplying electricity;
2. Requiring electricity production from GHG-emitting resources to ***bear the program's defined costs*** associated with such emissions; and
3. Further encouraging the installation and use of clean resources by ***providing them premium compensation*** (through wholesale electricity prices that include the cost of GHG emissions) for their clean supply.

Each of these goals is pursued for electricity produced within the applicable GHG program's jurisdiction and for electricity imported into that jurisdiction. When all three of these goals are achieved, powerful incentives are created to reduce the use of GHG-emitting resources (to avoid the GHG-pricing program's compliance costs), and to increase the installation and use of clean resources (to receive the higher wholesale electricity prices resulting from the inclusion of defined GHG emissions costs in market prices).

These three goals are readily achieved for generating units located within the GHG-pricing program's jurisdiction by imposing a compliance cost on all GHG emissions "at the smokestack." These GHG costs become part of the cost of producing electricity from those internal units and are reflected in wholesale electricity prices in the applicable jurisdiction, when such units are the marginal generating units producing electricity.

In contrast, it is much more challenging to accurately and fully achieve these three goals for wholesale electricity imported from outside of the program's jurisdiction. This is because GHG programs generally lack the authority to directly regulate GHG emissions outside of their jurisdiction and are therefore limited to regulating the import of electricity into their jurisdiction (through regulating the "First Jurisdictional Deliverer"). The challenge is that it can be difficult to accurately identify the specific external generation units that are producing the electricity (and their associated amount of GHG emissions) that enables the import of electricity into the GHG-pricing jurisdiction.

As the only active GHG-pricing program in the western U.S., the application of the California Cap and Trade Program to wholesale electricity imports is informative of how these challenges have been tackled to date.

Since its inception in 2013, the California Air Resource Board (CARB) has applied two distinct categories of electricity imports into California under the state's Cap-and-Trade Program:

1. **Unspecified Source Imports**: Imports that are from unspecified external sources incur a GHG compliance obligation based on a default emissions rate (0.428 Tonnes CO_2/MWh); and
2. **Specified Source Imports:** Imports that are demonstrated to be from a "specified source" incur a GHG compliance obligation based on the emissions rate of the identified external resource, which may be as low as zero for clean resources.

For imports that are arranged and delivered bilaterally to California load-serving entities, and for imports delivered into California via the CAISO's intertie bidding framework (*i.e.,* not including imports arranged through the Western EIM), the requirements for demonstrating a specified source import include:

a) providing evidence of ownership of output from the specified source;
b) providing evidence of production (generation meter data); and
c) providing evidence of direct delivery to California (e-Tags).

Imports arranged through the Western EIM, which launched in 2014, are not required to make this same demonstration. This is presumably because transactions in an organized market generally do not provide a readily available "link" between a specific generation source to a specific delivery to a load or location (i.e., there typically is no e-Tag between the specific generation dispatched to a specific load served). Instead, the design of the Western EIM includes a process in which the market software not only determines which external generators are dispatched, but also which external resources are "deemed" to be the source of imports into California, with these "deemed" generators reported as the "specified source" of those imports, and with their associated GHG emissions incorporated into the wholesale market prices for California.

This paper evaluates the effectiveness and accuracy of the Western EIM's "deeming" approach, through an in-depth analysis of how the underlying Western EIM's "deeming algorithm" actually works, together with a detailed examination of available data from the Western EIM for the 2021 calendar year.[1] ***This analysis and examination shows that California's GHG-pricing program is not being applied correctly in the Western EIM at all, and indeed the core objectives of the California Cap and Trade Program are being significantly undermined.***

While it has long been understood that the Western EIM's deeming algorithm results in some amount of GHG leakage through a specific type of inadvertent activity referred to as "secondary

[1] This paper was written by Powerex, which is a Western EIM participant and seller of clean and renewable electricity in western wholesale markets.

dispatch"[2], the analysis presented in this paper demonstrates that the problems with the algorithm go far beyond this limited issue. Rather, the Western EIM's deeming algorithm has a **primary dispatch** problem, whereby it routinely dispatches external coal and gas resources to serve load in California, while deeming the imports to come from clean resources that:

1. are offered at prices that are uneconomic for serving load in California (and would not have received a "primary dispatch");
2. do not increase their production in the Western EIM above their base schedules;
3. are not delivered to California; and/or
4. could not be delivered to California (due to insufficient transmission availability).

In fact, the Western EIM's deeming algorithm ***includes no link whatsoever*** between the resources that are incrementally dispatched to serve load in California, and the resources that the algorithm may select to be deemed to be delivered to California for GHG-emissions purposes. The algorithm will (and routinely does) dispatch high GHG-emitting external coal and gas resources, without specifically considering *their* GHG-emissions costs, and delivers them to California to serve California load. This generally occurs in two distinct ways:

1. *Displacement of Clean External Resources*: High GHG-emitting external resources routinely displace clean external resources (that are available to be dispatched in the Western EIM to serve California load) if the high GHG-emitting resources are even $0.01/MWh less expensive (ignoring their GHG costs) than the available external clean resources; and

2. *Displacement of California Natural Gas Resources*: Internal California natural gas resources are displaced by high GHG-emitting external resources if the cost of the external GHG-emitting resource—excluding its associated GHG emissions cost—is even slightly lower-priced (e.g., $0.01) than the available internal California resources, <u>including</u> *their* GHG-emissions costs; this occurs in any interval that the algorithm can identify a clean external resource anywhere in the EIM footprint to inaccurately "deem" to be the external resource delivered to California—even if the "deemed" clean resource doesn't increase its production in the Western EIM at all and/or it is not deliverable to California).

In effect, the Western EIM's deeming algorithm enables external, high GHG-emitting coal and gas resources to compete directly with both clean external resources and California natural gas resources to serve California load, <u>without</u> consideration of their GHG costs, and <u>without</u> imposing any GHG costs on those resources.

Most concerning, the analysis reveals that, on a persistent basis in the Western EIM:

[2] The secondary dispatch issue discussed in the industry to date refers to a situation in the Western EIM whereby a clean resource is notionally dispatched up and delivered to serve California load, and identified as a specified source import, while it is concurrently notionally dispatched down, and backfilled by GHG-emitting resources that are presumed to serve load in the source region of the clean resource.

- EIM BAAs in the Southwest sub-region (inclusive of the Rockies) with predominantly coal and natural gas resources are the largest sources of export supply in the very intervals that California BAAs are importing in the Western EIM; and
- Clean resources in multiple northwest BAAs are incorrectly "deemed" to be the source of those imports, as the quantities deemed are frequently well in excess of the applicable entity's total EIM exports in the applicable interval, and often occur when there are little, if any, EIM transfers from the northwest region to California.

As a result, the Western EIM is likely causing an <u>increase</u> in GHG emissions outside of the solar hours, and doing so to serve California load, as coal and higher-emitting gas resources in the Southwest are routinely displacing lower-emitting natural gas resources within California.

Five highly problematic outcomes of the Western EIM's approach to applying California's Cap and Trade Program are particularly notable:

1. High GHG-emitting coal and natural gas generating resources outside California enjoy incremental sales opportunities, without incurring GHG emissions costs, even though they are clearly being instructed to produce additional electricity to enable California to import electricity in the EIM. The available data indicates that this is occurring most extensively for resources located in the Southwest sub-region, particularly in the PacifiCorp East BAA.
2. Clean resources outside California that do not increase their output in the Western EIM (and/or are not delivered to California) are being "deemed" to be delivered to California, receiving compensation from California consumers for no discernable purpose. The available data indicates that this is occurring most extensively for clean, hydro resources located in the Idaho Power and Seattle City Light BAAs, but also noticeably in the PacifiCorp West and Portland General Electric BAAs.
3. Wholesale market prices in California are inappropriately suppressed (in the real-time market), as they do not accurately reflect the cost of GHG emissions associated with the marginal electricity production. This predominantly benefits wholesale market purchasers in California, particularly those load-serving entities in the CAISO BAA that are large net purchasers in the wholesale markets.
4. Clean resources located both inside and outside California that *do* produce and deliver wholesale electricity to California load are denied appropriate compensation for their clean supply (as a result of the inappropriately reduced California wholesale market prices).
5. No jurisdiction is taking environmental accountability for consuming the electricity from the high-emitting coal and natural gas generating resources, which is clearly being exported to serve load somewhere[3]. There does not even appear to be a general

[3] In California, there is some environmental accountability being taken for the acknowledged "secondary dispatch" problem, via CARB retiring additional GHG allowances to reflect its estimate of the leakage

recognition that either load in California or load in the Northwest BAAs (that have the hydro resources that are excessively "deemed delivered") is being served by the output of the high-emitting coal and natural gas generation that others are selling.[4]

It is important to note that the beneficiaries of the inappropriate outcomes described above, including the entities participating in the Western EIM in the above identified BAAs, are not the cause of these highly problematic outcomes. Rather, it is the Western EIM's highly flawed algorithm that is responsible for these results, as it is the algorithm that automates systemic resource shuffling, dispatching coal and other high-emitting resources to serve California demand while labeling it as clean hydro supply.

In summary, Powerex's analysis demonstrates that the Western EIM's approach to GHG emissions for electricity imports into California is deeply flawed and is undermining California's environmental policy objectives and the central tenets of California's Cap-and-Trade Program, as applied to the wholesale electricity sector. The Western EIM's flawed algorithm is causing higher-emitting Southwest coal and natural gas resources to displace lower-emitting California natural gas resources, while muting the price signal for clean generation to be installed, dispatched and delivered. It achieves this by inaccurately "deeming" California imports to be sourced from Northwest hydro resources that are not incrementally dispatched and/or delivered. Although the magnitude of this environmental harm is limited by the relatively small amount of trade activity that occurs in the Western EIM, the outcomes are so contrary to that market's GHG-related goals that there is a clear need to develop and implement a new approach. ***More importantly, the Western EIM's implementation of GHG-pricing for electricity imports must not be extended to other market timeframes or other jurisdictions***.

occurring in the Western EIM, based on the assumption that GHG emissions associated with external resources serving California load are at a rate equal to the unspecified rate of 0.428 tonnes/MWh (i.e., a combined cycle gas resource). However, as later described in this paper, the actual emissions of the external resources being exported to enable California imports is likely significantly higher, as coal and other high GHG-emitting resources are frequently producing electricity in the exporting BAAs.

[4] The failure to assign the GHG emissions associated with the electricity produced from these high-emitting resources to any entity (or any jurisdiction) will likely become even more concerning in the future as additional GHG-pricing programs are implemented in western states (such as Washington's Cap and Invest Program, which will be operational in 2023).

The Extent Of The Flaws In The Western EIM's GHG Deeming Algorithm Are Not Well Understood

It has long been understood by the California Air Resources Board (CARB), the California Independent System Operator (CAISO), and many of the stakeholders participating in western wholesale electricity market discussions that the Western EIM's GHG deeming algorithm (for determining which external resources are the specified sources "deemed delivered" to California) is imperfect. Specifically, there is a widely known issue that results in GHG-emissions leakage, which is described by the CAISO as a "secondary dispatch" issue. This secondary dispatch issue occurs under circumstances in which:

1) An external clean (or low-emitting) resource is identified as economic to increase its output to enable electricity imports into California to serve California load (i.e., it receives a notional "primary dispatch");

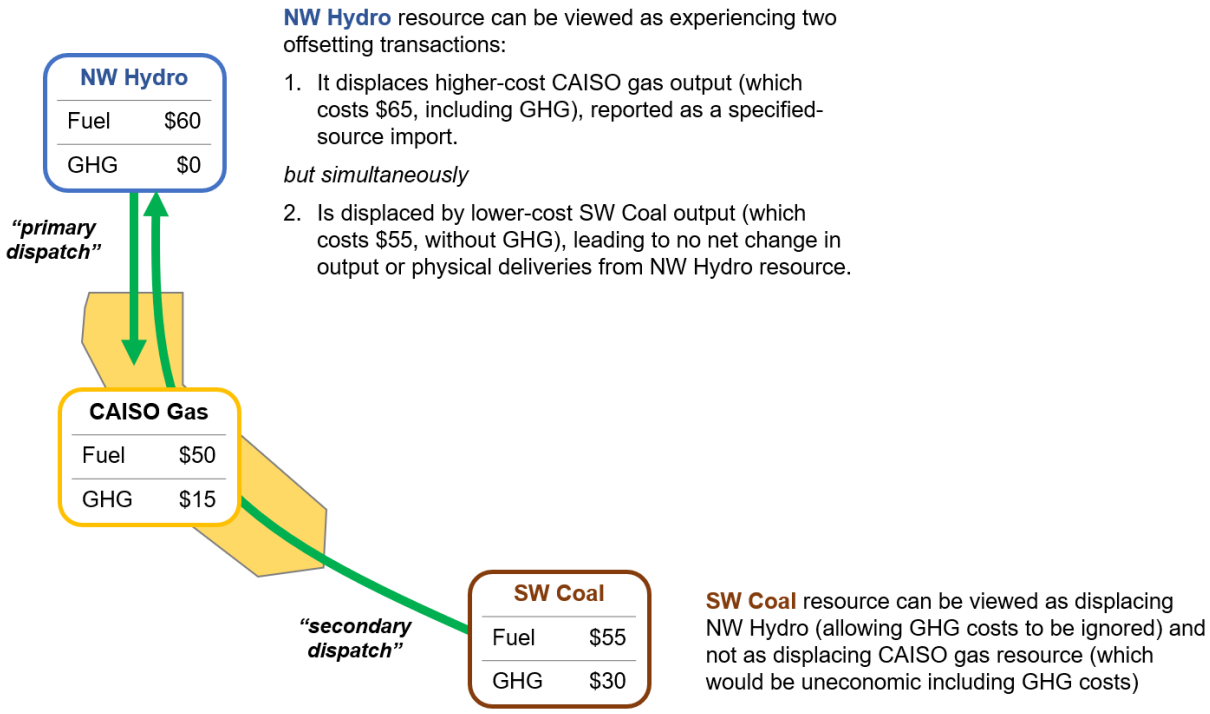
2) An external GHG-emitting resource is identified as economic to increase its output to serve load in the source region of the clean (or low-emitting) resource (i.e., it receives a notional "secondary dispatch") which, in turn, causes the external clean resource to reduce its output back down (partially or wholly offsetting its primary dispatch); and

3) This activity occurs concurrently, with both resources only receiving their net dispatch instruction.

The net result of this activity is that the external clean (or low-emitting) resource may not increase its output in the Western EIM at all, yet its output is "deemed delivered" to California for which it receives a payment (at the "GHG shadow price") for being willing to report to CARB and pay its resource-specific GHG-related emission costs (which is zero for a clean resource). At the same time, the external GHG-emitting resource that increases its output and delivers electricity into California is not "deemed delivered" to California and faces no GHG-related emissions costs.

This is illustrated below:

Illustration 1: An Example Of "Secondary Dispatch"



As a result of CARB's awareness of this secondary dispatch activity, and the corresponding "leakage" of GHG emissions, CARB has put in place provisions to retire additional GHG allowances (in an effort to mitigate this leakage).

Critically, however, the leakage that is occurring in the Western EIM extends far beyond the known secondary dispatch issue described above*,* as a closer examination of the Western EIM's deeming algorithm reveals that:

1) There is no requirement that the clean (or low-emitting) resources that are "deemed delivered" to California are economic to serve load in California in the first place; and

2) There is no requirement that any transmission capability exists to deliver the clean (or low-emitting) resources that are "deemed delivered" to California.

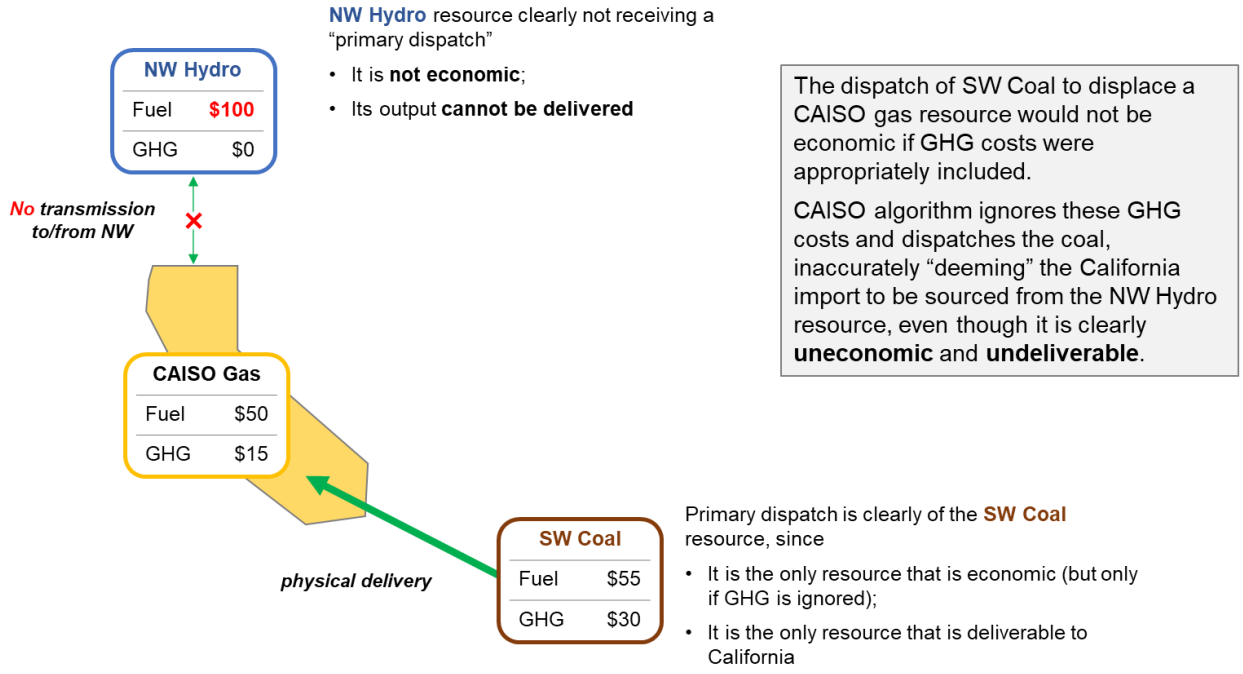
In short, there is no requirement whatsoever that a resource that is "deemed delivered" to California would (or even could) be dispatched and delivered to serve load in California (i.e., no check that a "primary dispatch" would have happened, but for the presumed "secondary dispatch" of another resource to backfill its output).

This results in the leakage problem in the Western EIM extending far beyond the known "secondary dispatch" problem to a broad and pervasive "primary dispatch" problem associated with external GHG-emitting resources. This is because the Western EIM's GHG deeming algorithm is free to (and routinely does) dispatch external GHG-emitting resources and deliver that output to serve load in California, whenever it can identify a clean (or low-emitting)

resource anywhere in the external footprint to act as a conduit for that import by being "deemed delivered" to California. The resource that is "deemed delivered" need not be economic to serve load in California (or economic to increase its output to serve load anywhere for that matter) and it need not be deliverable to California (as deliverability is not considered by the algorithm). In these circumstances, the clean resource cannot credibly be viewed as having a "primary dispatch" that is backfilled with a "secondary dispatch" of the GHG-emitting resource, since the clean resource would have never been dispatched and delivered to California, whether the GHG-emitting resource was available to backfill it or not. It is the GHG-emitting resource, and only the GHG-emitting resource, that is (and ever would be) dispatched, and hence it is the specific resource that is receiving a primary dispatch and is being delivered to, and serving load in, California.

This is illustrated below:

Illustration 2: An Example Of Inaccurate "Deemed Deliveries"



This extensive primary dispatch issue has far-reaching implications. Perhaps most critically, a closer examination of the Western EIM reveals that, despite being referred to as a specified-source framework, it fails to apply the key defining elements of a specified-source approach. Specifically, notably absent in the Western EIM's "deemed delivery" approach to imports into California are at least three critical elements that are fundamental to the specified-source approach:

1) Whether or not a specific resource is dispatched depends both on its fuel cost and *that resource's* GHG costs.

2) The entity responsible for importing the specific resource that is dispatched to serve California load is the *same entity* responsible for reporting its GHG emissions to CARB and paying GHG emissions costs.

3) GHG emissions costs are based on the GHG emissions rate of the *specific resource that is dispatched* and imported to serve California.

The Western EIM does not do any of this. First, the Western EIM evaluates whether to dispatch a particular external resource based on that resource's fuel cost only; its GHG cost does not determine its dispatch. Second, the Western EIM assigns the reporting and GHG emissions cost obligation to the external resource that it "deems delivered", rather than the external resource that it dispatches to serve California load. Third, the GHG emissions rate and associated costs are not based on the external resource that is dispatched to serve California load, but instead on the external resource that the Western EIM "deems delivered."

The Western EIM can thus more accurately be viewed as a framework for *unspecified* imports. Under an unspecified import approach, electricity is produced by the external resource with the lowest fuel cost (*i.e.,* ignoring its GHG emissions), and the GHG emissions costs applied to the import of electricity into California are established separately, independent of the GHG emission rate of the resource(s) that actually produced the electricity that was imported. This separate GHG emissions cost acts as a hurdle rate for unspecified imports. But whereas the GHG emissions rate for unspecified imports that occur outside of the Western EIM has been established by CARB (at 0.428 tonnes/MWh), the GHG emissions rate applied to imports in the Western EIM is established by the Western EIM's software based on the lowest GHG-emitting resource that is willing and able to be "deemed delivered." ***The hurdle rate established by the Western EIM's "deeming" approach thus is very frequently well below CARB's unspecified rate, and is most often zero***.

There are multiple additional characteristics of the Western EIM "deeming" approach that more closely resemble the unspecified-source approach than the specified-source approach it purports to be:

1) **No specified-source reporting requirement or GHG-emissions costs apply to the owner/seller of the external resources that are serving California load,** as external GHG-emitting resources can be routinely dispatched and delivered to California to serve load in California, without being treated as "specified-sources", and without their owners/sellers being responsible for reporting to CARB and paying their GHG-related costs.

   This is most similar to when an owner/seller of an external GHG-emitting resource sells their output in the external bilateral markets as "unspecified source" output and bears no specified-source reporting obligation (and no GHG-emissions costs) if that electricity is then imported into California to serve California load.

2) **Responsibility for reporting and compliance for electricity imports into California is assigned to entities *other than* the owner/seller of the external resources that actually increase production of electricity**. Furthermore, the compliance costs associated with California imports are based on the GHG-related costs of the "deemed" entity, and not on the GHG-related costs of the resources that increase production.

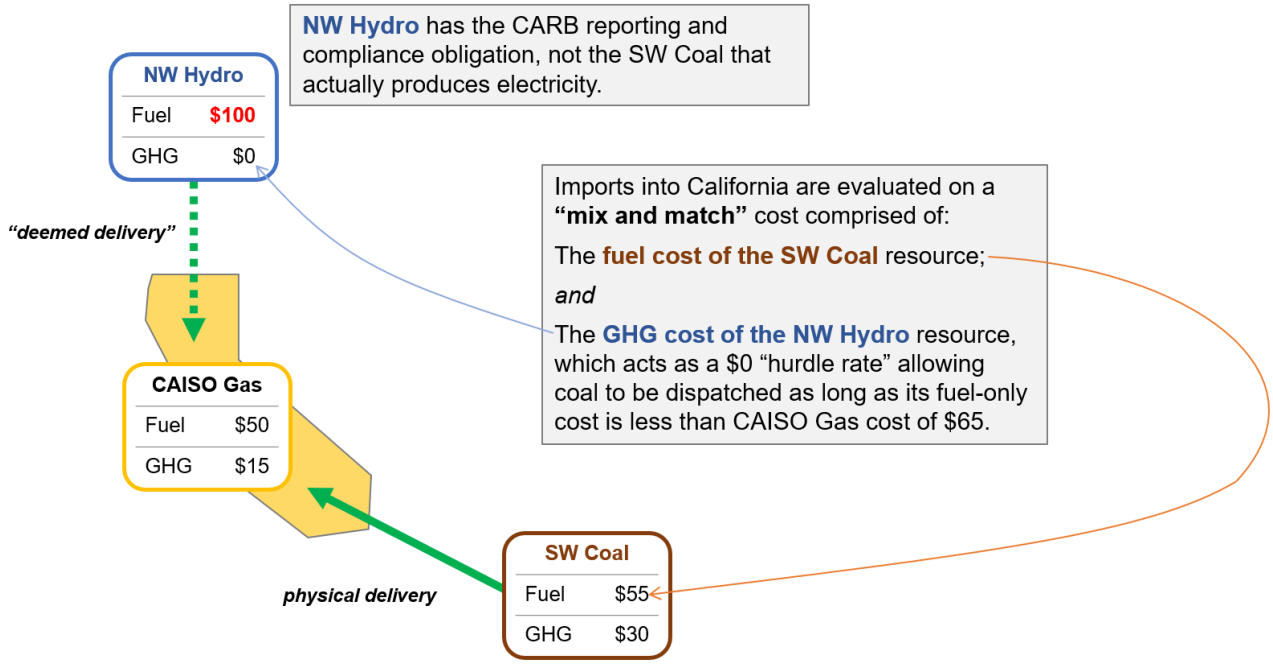
   This is most similar to when a purchaser of unspecified output in the external bilateral markets delivers that "unspecified source" output to serve California load; it is not the resource owner/seller of the imported supply that bears the CARB reporting obligation and related GHG-emissions costs, but a different entity (the identified importer into California), with the GHG-emissions rate applied being unrelated to the GHG-emissions rate of the actual source of the imported electricity.

3) **External GHG-emitting resources delivered to California to serve load in California face an implicit hurdle rate** (which is unrelated to their own GHG-emissions rate)**,** as external GHG-emitting resources will be dispatched to serve load in California if they are economic based on only their fuel (offer costs) plus the (new and variable) hurdle rate.

   However, in contrast to CARB's prescribed fixed "unspecified source" GHG-emissions rate (fixed at 0.428 tonnes/MWh), which is designed to act as a hurdle rate for imports that occur outside of the Western EIM, the effective "unspecified" hurdle rate in the Western EIM is set by the GHG-emissions rate of the supply stack of resources willing to be "deemed delivered" to serve load in California. ***Importantly, this "deemed delivered" supply stack is entirely independent from which specific resources are dispatched and delivered to serve load in California***; it starts at 0 tonnes/MWh, only increasing above this rate to the extent there is insufficient clean resources able and willing to be "deemed delivered."

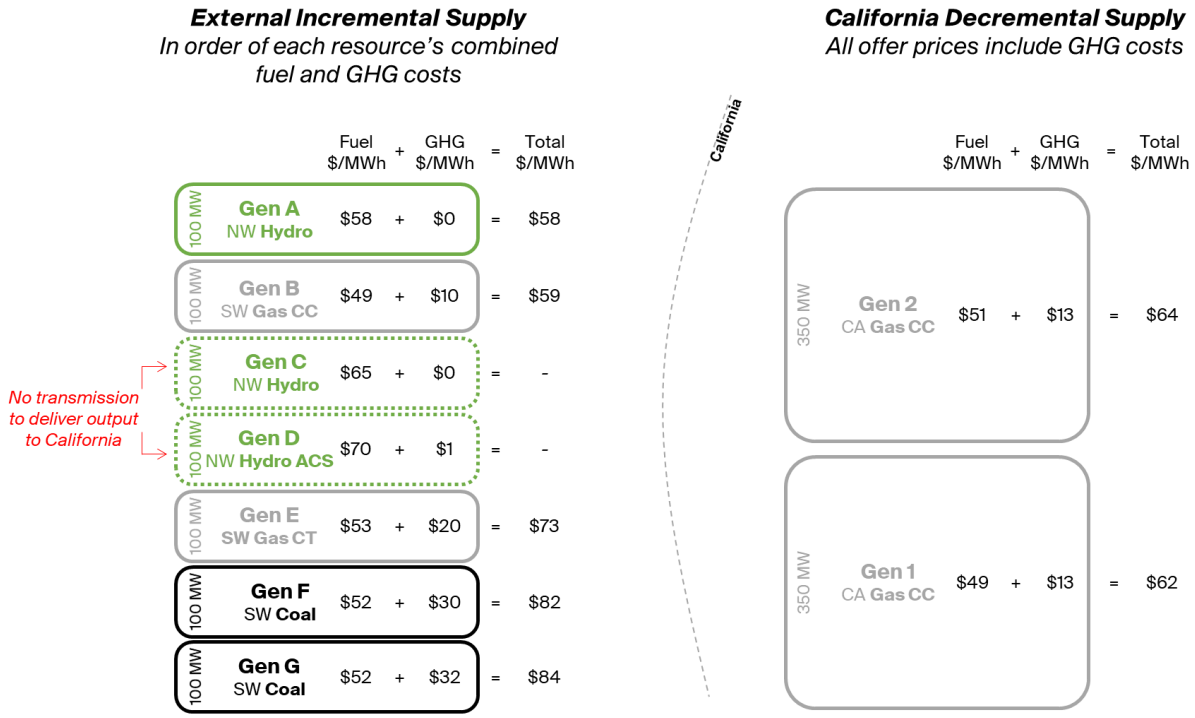
This is illustrated below:

Illustration 3: The GHG Cost Of Resources Inaccurately "Deemed Delivered" Is The Hurdle Rate Applied To The Dispatch Of GHG Emitting Resources Serving California Load



This is perhaps best illustrated with a more complete numeric example, utilizing a hypothetical mix of available resources in the Western EIM, as summarized below:

Illustration 4: External And Internal Generator Supply Offers



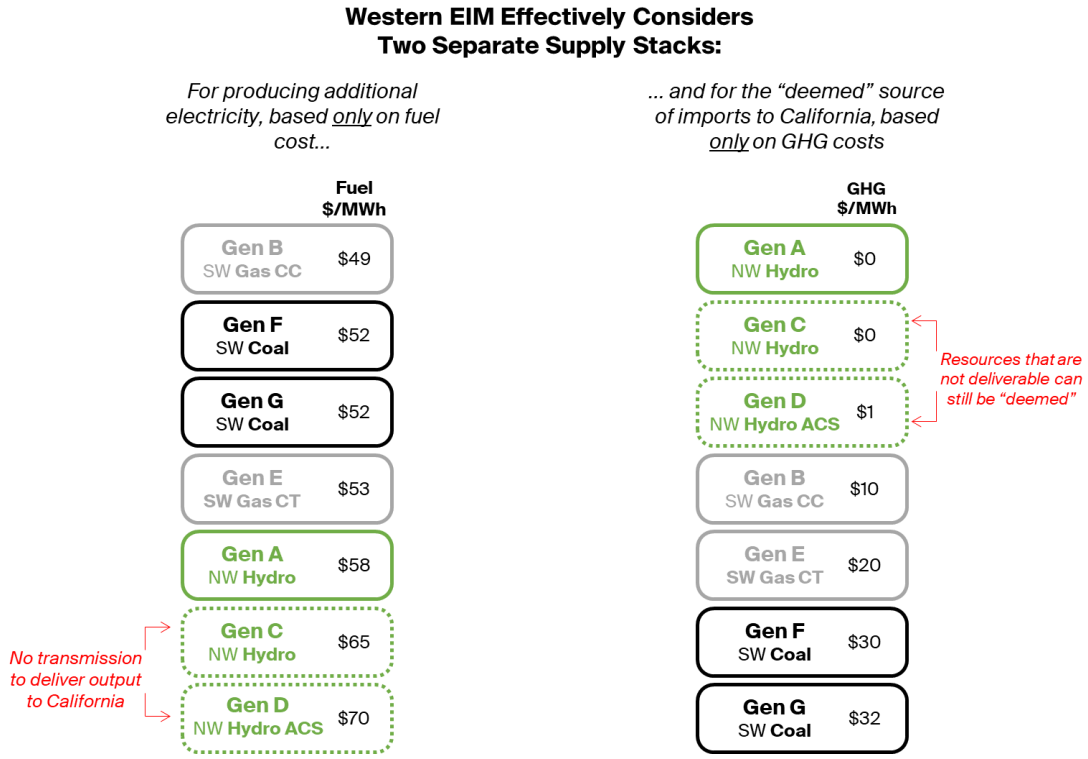
It is clear from a quick review of the resources set forth above that the efficient dispatch outcome (with accurate application of the California Cap and Trade Program to specified-source imports) would be to:

- Fully dispatch external Generator A ($58/MWh) and Generator B ($59/MWh) to produce an additional 100MW each; and
- Import the electricity in order to reduce the output of California Generator 2 ($64/MWh) by 200MW.

There are no additional remaining opportunities for beneficial transactions, since all remaining external supply that is deliverable to California has a higher cost (including GHG costs) than the California resource it would be displacing.

However, as illustrated below, the Western EIM's GHG "deeming" algorithm considers the cost-minimizing optimization challenge in a very different way, resulting in a very different dispatch, pricing and settlement outcome. Specifically, the algorithm effectively considers two entirely independent supply stacks: one for the production of electricity (based only on the fuel cost), and a separate one for being "deemed delivered" (based only on the GHG cost), as follows:

Illustration 5: Separation Of External Supply Stack



In its consideration of which specific external resources to incrementally dispatch to enable exports to California (left-hand supply stack, above), the algorithm does not specifically consider *that resource's* GHG-emissions costs or whether *that resource* is willing to be "deemed delivered" to California. In this example, *all* of the external resources that are deliverable have fuel costs that are less than the cost of in-state California Generator 1 and Generator 2, and are therefore potentially economic to import into California *provided* that the Western EIM algorithm can find some resource willing and able to be "deemed" at a sufficiently low GHG cost.

Similarly, in its consideration of which specific external resources are "deemed delivered" to California (right-hand supply stack, above), the algorithm does not specifically consider *that resource's* dispatch costs (*i.e.*, its offer or fuel price), whether *that resource* is deliverable to California, or whether *that resource* is incrementally dispatched in the Western EIM at all.[5] In this example, external Generators A and C are each willing (and eligible) to act as the "deemed" source for 100 MW of imports, and do so at a price of $0; Generator D is willing (and eligible) to act as the "deemed" source for 100 MW at a price of $1/MWh, and so on. This is effectively a

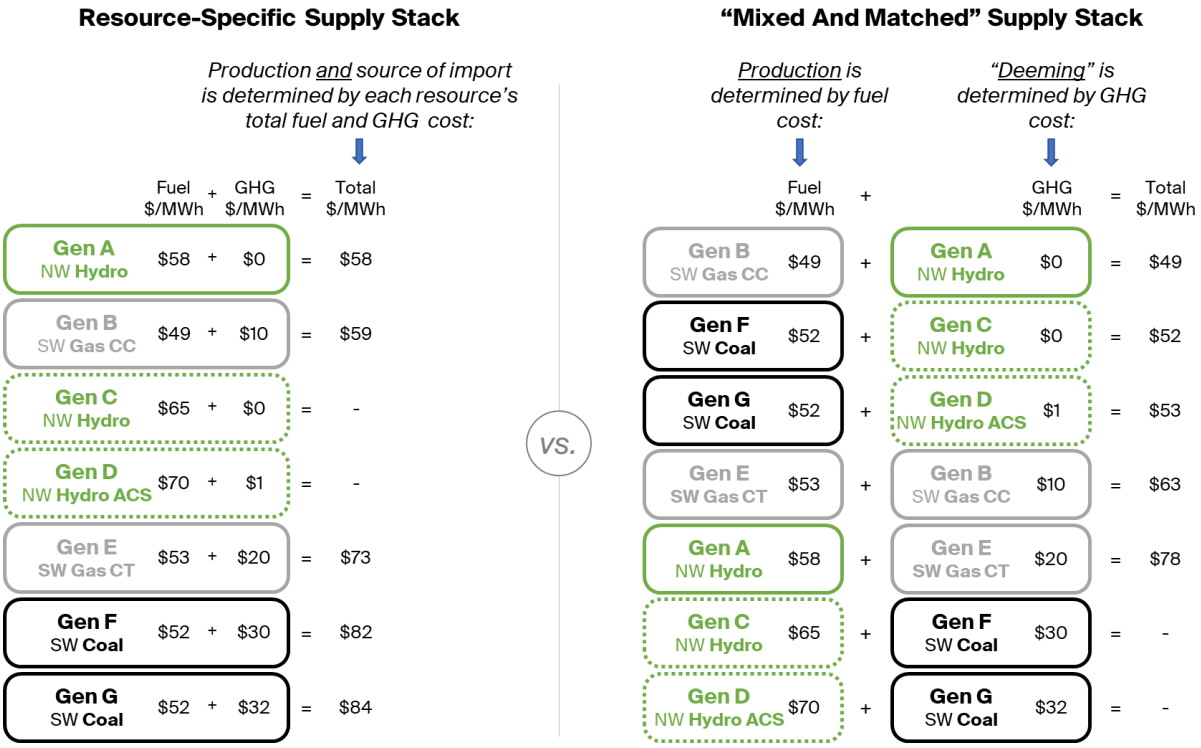
[5] It only considers that resource's willingness to be deemed and applies the lesser of:
(i) its total output (including the output that has been base scheduled to serve native load in the source BAA outside of the Western EIM); and
(ii) the quantity it *could be* incrementally dispatched
as a limit on the quantity that can be deemed delivered from that resource.

list of offers that acts as a conduit for importing *any* resource's output into California, *regardless of which external resource actually produces the electricity that enables the import.*

In the illustration above, the only connection between these two supply stacks in the algorithm's decision-making is that the total quantity of electricity imported by California to serve California load must be equal to the total quantity that has been "deemed delivered."

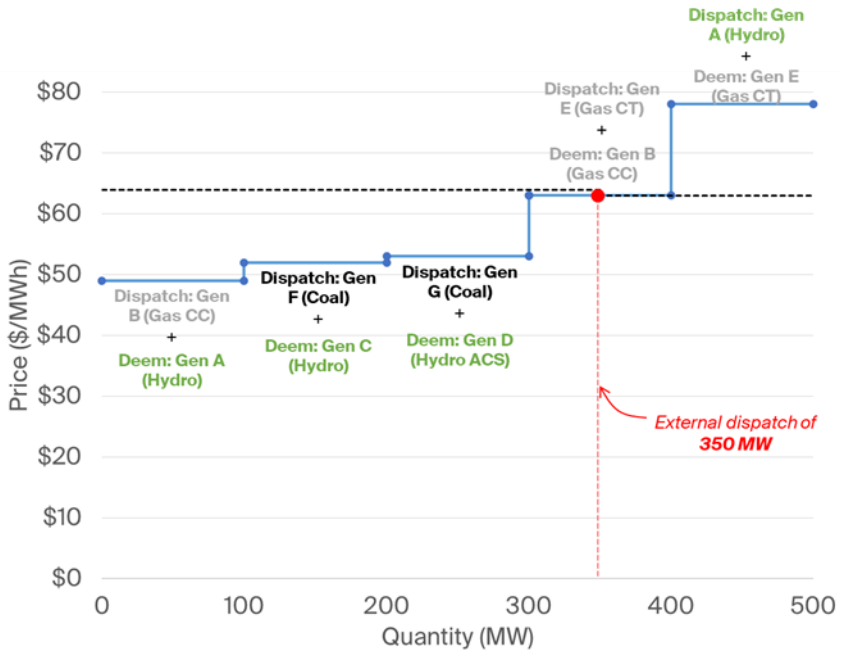
This results in the algorithm effectively having a "mixed and matched" joint supply stack available to serve California load. The figure below shows the difference between a fully resource-specific approach (left) and the Western EIM's "mix and match" approach (right):

Illustration 6: Comparison Of Resource-Specific vs. "Mixed And Matched" Supply Stacks



When the two different supply stacks—one for dispatch, and the other for "deeming" of imports—are combined, the final selection of dispatch and deeming decisions based on the "mixed and matched" approach are shown below:

Illustration 7: Effective Joint "Mixed and Matched" External Supply Stack Available For Dispatch And Delivery To California



The "mixed and matched" supply stack shown above makes it abundantly clear that the Western EIM algorithm's flaws extend well beyond the secondary dispatch issue. ***It vividly illustrates that the Western EIM has not actually applied a true "specified-source" approach to applying GHG-emissions to external resources dispatched to serve California load at all, since it is generally the GHG-emissions of <u>other</u> resources that are considered.***

Specifically, each external generator faces a different hurdle rate (based on other resources' GHG costs), which is combined with its own offer price (but excluding its own GHG emissions costs) to determine whether it should be dispatched to serve California load, displacing California generation:

1) Generator B (SW gas) faces a $0/MWh hurdle rate set by Generator A (NW hydro)
2) Generator F (SW coal) faces a $0/MWh hurdle rate set by Generator C (NW hydro)
3) Generator G (SW coal) faces a $1/MWh hurdle rate set by Generator D (NW hydro ACS)
4) Generator E (SW gas) faces an $10/MWh hurdle rate set by Generator B (SW gas)
5) Generator A (NW hydro) faces a $20/MWh hurdle rate set by Generator E (SW gas)

In considering the effective "mixed and matched" joint supply stack for external resources set forth above, the Western EIM algorithm would dispatch 350MW of external resources to serve load in California, namely:

- External Generators B (SW gas), F (SW coal), and G (SW coal), for 100MW each; and
- External Generator E (SW gas) for 50MW

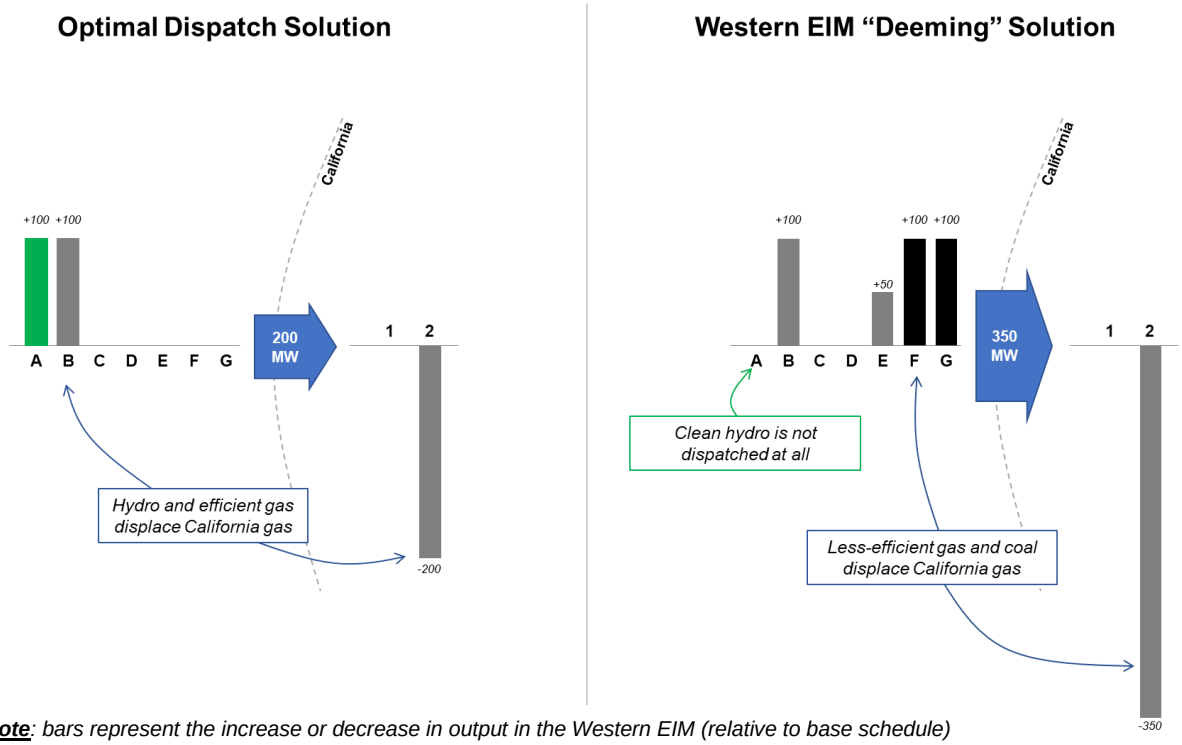
It would separately "deem delivered" the 350MW of electricity imports that is imported into California to serve California load to be sourced from:

- External Generators A (NW hydro), C (NW hydro), D (NW hydro ACS), for 100MW each; and
- External Generator B (SW gas) for 50MW

It does this because it views this "mixed and matched" dispatch solution as costing between $49/MWh and $63/MWh to displace California Generator 2 at $64/MWh.

The Western EIM's "deeming" approach leads to outcomes that are starkly different from the optimal solution when each resource's fuel and GHG costs are considered in the dispatch decisions. As illustrated below, the Western EIM fails to dispatch the clean hydro resource, and instead dispatches higher-emitting natural gas and coal resources in order to reduce the output of the lower-emitting in-state resource:

Illustration 8: Comparison Of Optimal Dispatch Solution And Solution Under Western EIM "Mix And Match" Approach



***Note**: bars represent the increase or decrease in output in the Western EIM (relative to base schedule)*

A closer examination of the dispatch, pricing and settlement outcome from the hypothetical example above further highlights that the dispatch under the Western EIM's "deeming" approach:

1. Is less efficient (*i.e.,* higher total cost) than the optimal solution;
2. Increases GHG emissions to serve California load; and
3. Creates benefits for activity that is contrary to the goal of reducing GHG emissions.

First, let's examine the economic inefficiency of the dispatch outcome:

Table 1: Analysis Of External Supply Dispatched And Delivered To Serve California Load

External Generator	Region	Resource Type	Quantity Dispatched And Delivered To California Load	Fuel Cost ($/MWh)	GHG-Emissions Costs ($/MWh)	Total Costs Including GHG Emissions ($/MWh)	Total Costs Of Displaced California Generation Including GHG Emissions ($/MWh)	Economic Benefit / (Loss) in $/MWh
B	SW	Gas (CC)	100	$49.00	$10.00	$59.00	$64.00	$5.00
F	SW	Coal	100	$52.00	$30.00	$82.00	$64.00	($18.00)
G	SW	Coal	100	$52.00	$32.00	$84.00	$64.00	($20.00)
E	SW	Gas (CT)	50	$53.00	$20.00	$73.00	$64.00	($9.00)

As can be seen above, external Generator F, G, and E are dispatched and delivered to California to serve California load, but are actually uneconomic as they are more expensive ($73/MWh to $84/MWh), *once their own resource-specific GHG costs are considered*, than the California Generator 2 ($64/MWh) that is being displaced.

This outcome also goes far beyond the "secondary dispatch" issue. Recall that "secondary dispatch" occurs when a resource that was appropriately and economically dispatched to serve California load (*i.e.,* hydro Generator A) is simultaneously "backfilled" by an external resource with lower fuel costs. Arguably, "secondary dispatch" might explain why hydro Generator A is "deemed delivered" but does not produce additional electricity, while coal Generator F *is* dispatched and is not "deemed delivered." But "secondary dispatch" cannot explain the dispatch of 100MW of coal Generator G, and the 50MW dispatch of gas CT Generator E. Neither of these resources can be said to be displacing an external resource that received a "primary dispatch" to serve California load. By the same token, the external resources that *are* "deemed delivered" in this example (*i.e.,* hydro Generator C and hydro ACS Generator D) were not economic to displace California generation, and their output could not be delivered to California even if it was economic. In other words, these resources cannot be viewed as receiving a "primary dispatch" that was simultaneously back-filled by other resources. As explained previously, the flaws in the Western EIM "deeming" approach are far more extensive than the "secondary dispatch" issue, and lead to systemic inaccuracy in the "primary dispatch" of external resources.

Second, let's examine the impacts to GHG emissions resulting from this dispatch outcome:

Table 1, above, also illustrates how external, higher-emitting coal and gas resources are dispatched incrementally to displace a lower-emitting California natural gas resource. Here, external Generators F, G, and E are dispatched incrementally, and their output is delivered to

California to serve load in California, yet they all have higher GHG emissions and higher GHG emissions costs, ranging from $20/MWh to $32/MWh, than California Generator 2, at $13/MWh, which is the internal California resource being displaced.

Third, let's examine which resources are deemed delivered to California to serve California load:

Table 2: Analysis Of External Supply Deemed Delivered To Serve California Load

External Generator	Region	Resource Type	Quantity Dispatched	Deliverable To California	Quantity Deemed Delivered To Serve California Load	GHG Shadow Price Paid To All Entities Deemed Delivered ($/MWh)
A	NW	Hydro	0	Yes	**100**	**$10.00**
C	NW	Hydro	0	No	**100**	**$10.00**
D	NW	Hydro ACS	0	No	**100**	**$10.00**
B	SW	Gas	100	Yes	**50**	**$10.00**
F	SW	Coal	100	Yes	**0**	n/a
G	SW	Coal	100	Yes	**0**	n/a
E	SW	Gas (CT)	50	Yes	**0**	n/a

Table 2 illustrates that:

- External Generator A (NW hydro) is inappropriately paid $1000 (100MW x $10/MWh) for being deemed delivered to serve California load even though it is not incrementally dispatched;
- External Generator B (SW gas) is dispatched for 100 MW, with 50MW also being "deemed delivered" to California for which it is appropriately paid $500 (50MW x $10/MWh). It will also incur a GHG-emissions cost at its resource-specific GHG-emissions rate for 50 MW. Note, however, that the remaining 50MW of its dispatched output was not "deemed delivered" to California at all (even though in this example, California is the only area receiving imports).
- External Generator C (NW hydro) is inappropriately paid $1000 (100MW x $10/MWh) for being deemed delivered to serve California load even though it was not incrementally dispatched; and
- External Generator D (NW hydro ACS) is inappropriately paid $1000 (100MW x $10/MWh) for being deemed delivered to serve California load even though it was not incrementally dispatched.

In summary, instead of efficiently:

- dispatching and delivering 100MW of NW hydro and 100MW of SW gas
- to displace 200MW of California in-state gas generation
  (the most efficient outcome previously described),

the Western EIM:

- dispatches and delivers 200MW of SW coal and 150MW of SW gas
- to displace 350MW of California in-state gas generation.

This example demonstrates that the Western EIM's deeming algorithm is not only highly suboptimal from a GHG emissions perspective relative to the optimal dispatch solution, it also undoubtedly results in an increase in GHG emissions relative to no EIM dispatch at all. Moreover, hydro resources that produce no additional electricity at all receive considerable compensation merely for serving as the conduit for "deemed deliveries" of electricity produced by different, GHG-emitting resources.

Finally, let's examine the impact to the market prices in California:

In the optimal dispatch scenario, California market prices would be set by California Generator 2, at $64/MWh, since it would be the lowest cost resource available to serve the next MW of California load (*i.e.,* it would be displaced down by 200MW by the imports of electricity from external Generators A and B, and thus has the ability to increase output to meet additional demand).

However, under the outcome that would occur with the Western EIM's GHG deeming algorithm, California market prices would be set by the ability of the algorithm to incrementally dispatch one more MW of output from external Generator E (SW gas) at a fuel cost of $53/MWh, while deeming the additional imported electricity to come from external Generator B (SW gas) at a GHG-emissions cost of $10/MWh. This results in a California market price of $63/MWh, which is inefficiently reduced by $1/MWh below the efficient market price of $64/MWh. It is important to note that while a $1/MWh savings may not appear to be substantial, this would generally lower the wholesale market price that load-serving entities in California would pay for all of their real-time supply, amounting to a very sizeable savings. Moreover, in practice, this price suppression effect is likely to be significantly greater than $1/MWh, since dozens of external GHG-emitting generators can be dispatched to serve load at artificially low "mixed and matched" offer prices (i.e., at the combination of each generator's fuel costs and an unrelated NW hydro generator's GHG-emissions costs of $0/MWh)

In sum, the above illustrative example highlights several important and highly troublesome aspects of the Western EIM's algorithmic approach to "deeming deliveries" to California for GHG reporting and compliance purposes:

- the GHG costs of the specific external resources dispatched to serve load in California are not the specific costs considered in the Western EIM's decision to dispatch those resources (to serve California load);

- high GHG-emitting resources can be dispatched and delivered to California to serve California load anytime there are lower-emitting external resources—located anywhere

and at any cost—that can be inaccurately "deemed delivered' to California to match the quantity of EIM imports into California; and

- the Western EIM's approach results in economically inefficient outcomes that are harmful to society, as:

    - higher cost external resources can be routinely dispatched to serve California load, displacing lower cost California resources; and

    - higher-emitting external resources (e.g., coal resources) can be routinely dispatched to serve California load, displacing lower-emitting California resources (e.g., gas resources).

The beneficiaries of these inefficiencies include:

- external high-emitting external resources which enjoy new, attractive sales opportunities in the Western EIM, as they can be routinely dispatched to serve California load without bearing any GHG emissions costs;

- external clean and low-emitting external resources that receive payments in the Western EIM (at the GHG shadow price) for being deemed delivered to California when they are not incrementally dispatched at all, including in circumstances when they are not economic to serve load in California and/or may not be deliverable to California due to insufficient transmission capability[6]; and

- wholesale market purchasers in California (e.g., California load-serving entities), which enjoy inefficiently lowered California wholesale market prices as a result of understated GHG emissions costs associated with imported electricity.

The entities harmed by these inefficiencies include:

- clean resources (both internal and external to California) that should have been dispatched, but were inefficiently displaced by external high-emitting resources (that would not have been dispatched to serve California load if their GHG emissions costs were properly recognize);

- California natural gas resources that should have been dispatched, but were inefficiently displaced by external high-emitting resources (that would not have been dispatched to serve California load if their GHG emissions costs were properly recognized);

- all internal and external resources that were correctly dispatched to serve California load and properly assigned GHG emissions costs, as they received reduced payments for

[6] Moreover, clean, fuel-limited resources (such as those storage hydro resources with limited water availability) can be "deemed delivered" hour after hour, since they never need to generate and deplete their fuel in order to be "deemed delivered" and receive the corresponding GHG-related payments.

their wholesale market sales, due to the inefficiently lowered California wholesale market prices; and

- society more generally, as the GHG-pricing program and its environmental objectives are not achieved (i.e., GHG emissions are not reduced as intended).

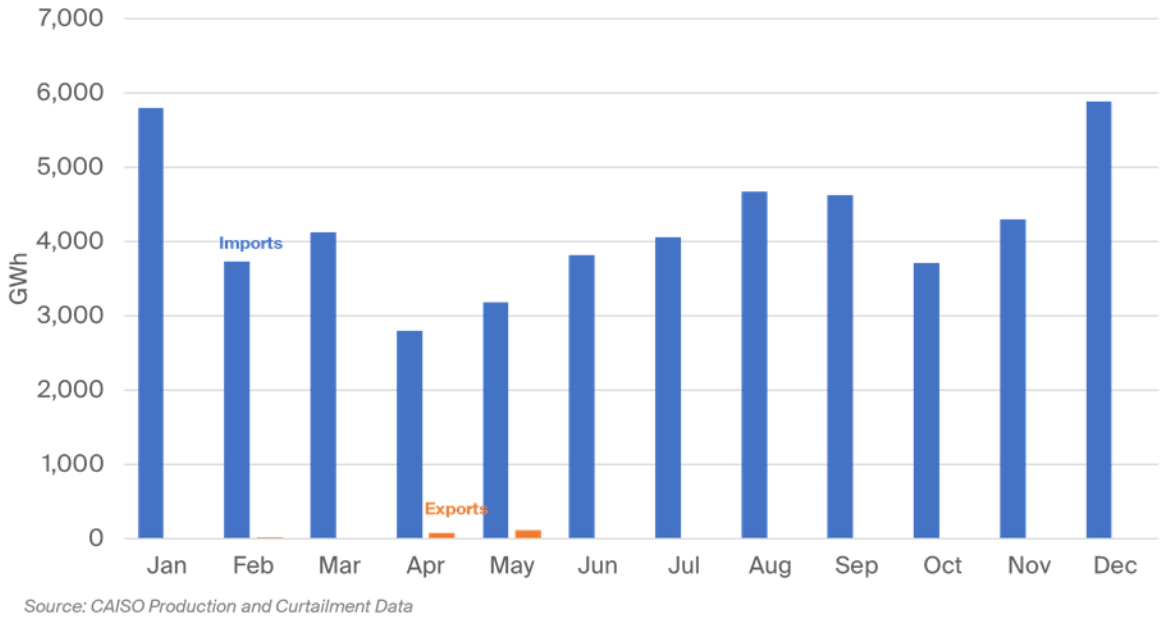
The following section examines the real-world outcomes, through a detailed analysis of available data for the most recent calendar year of 2021.

Background And Context Of California Import Activity In The Western EIM

This section provides background and context on California import activity to provide context for the subsequent detailed analysis that is focused on the application of California's Cap and Trade Program to California imports in the Western EIM. This background and context is focused on the CAISO BAA, as data is readily available for this BAA, which is by far the largest in California.

California—and the CAISO balancing authority area ("BAA") in particular—is a large importer of electricity from the rest of the Western Interconnection. In 2021 for instance, the CAISO BAA was a net importer of electricity from the rest of the west in 97% of all 5-minute intervals, with those imports totaling 50,689 GWh. In contrast, the CAISO BAA was a net exporter to the rest of the west in only 3% of intervals, with those exports totaling 231 GWh, or about 0.5% of its imports.

Chart 1: Total Exports And Imports Of The CAISO BAA By Month, 2021

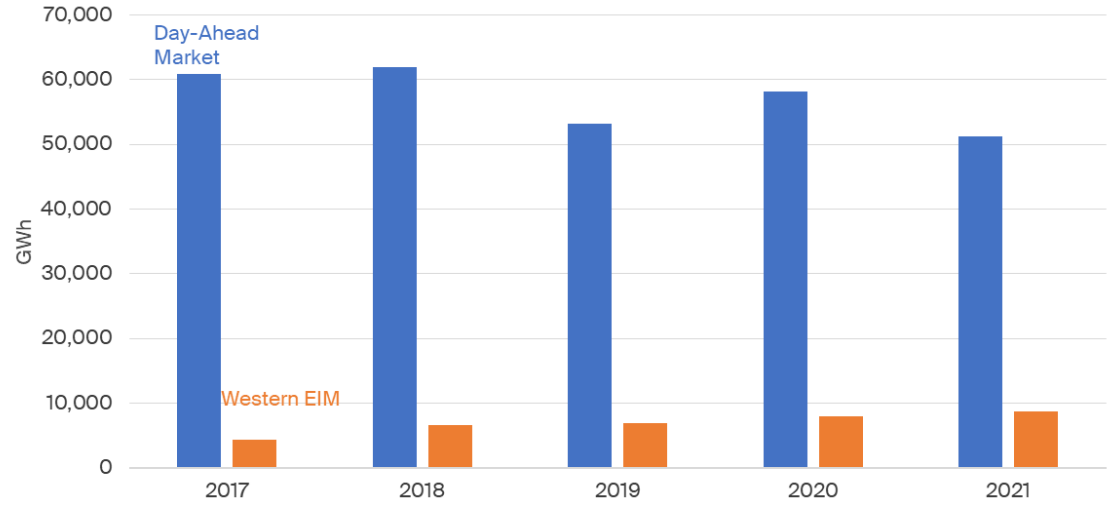


Source: CAISO Production and Curtailment Data

Within this broader wholesale market activity, a portion of the CAISO BAA import activity occurs in the Western EIM, with such activity having a handful of distinguishing features, including:

1. The Western EIM volumes are relatively small, as it is a real-time, sub-hourly market.

Chart 2: Total Exports And Imports (Combined) For The CAISO BAA By Year, 2017 – 2021

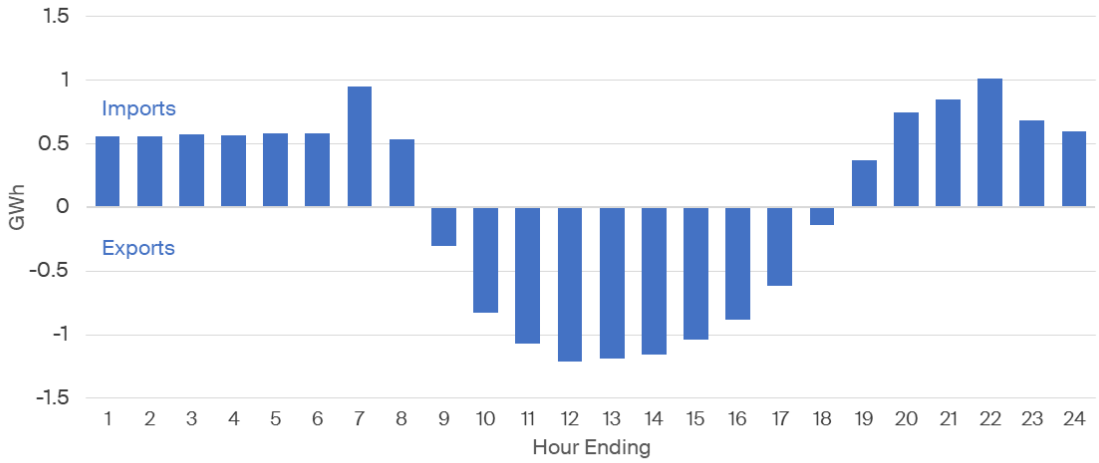


Source: CAISO OASIS

2. The CAISO BAA's import and export activity in the Western EIM—unlike its overall wholesale market activity—is largely balanced between imports and exports; and

3. The CAISO BAA's activity in the Western EIM follows highly predictable patterns: exporting during the hours of solar production, and importing in most other hours.

Chart 3: Average Exports And Average Imports Of The CAISO BAA In The Western EIM, 2021



Source: CAISO OASIS

Evaluating The Accuracy Of GHG Attribution For California Imports In The Western EIM

The focus of this analysis is to evaluate the accuracy of the application of California's GHG-pricing program to imports into California that are transacted in the Western EIM. It is recognized that California is also an exporter of energy in the Western EIM in many hours, primarily during the midday solar supply hours. The Western EIM has been successful in facilitating exports from the CAISO BAA (and other California BAAs) that might not otherwise have occurred and can therefore be viewed as supporting environmental policy goals by reducing curtailments of renewable generation, particularly by helping deal with solar oversupply challenges in certain hours in certain months. Reductions in external GHG emissions associated with exports out of California are beyond the scope of California's GHG-pricing program, however. This is because reduced renewable curtailments are attributable to the existence of a real-time organized market and are independent of the existence (and approach to applying) California's GHG-pricing program.

Accordingly, this evaluation of the accuracy of the Western EIM's application of California's GHG-pricing program necessarily examines only those market intervals in which California was a net importer of energy in the Western EIM during 2021.

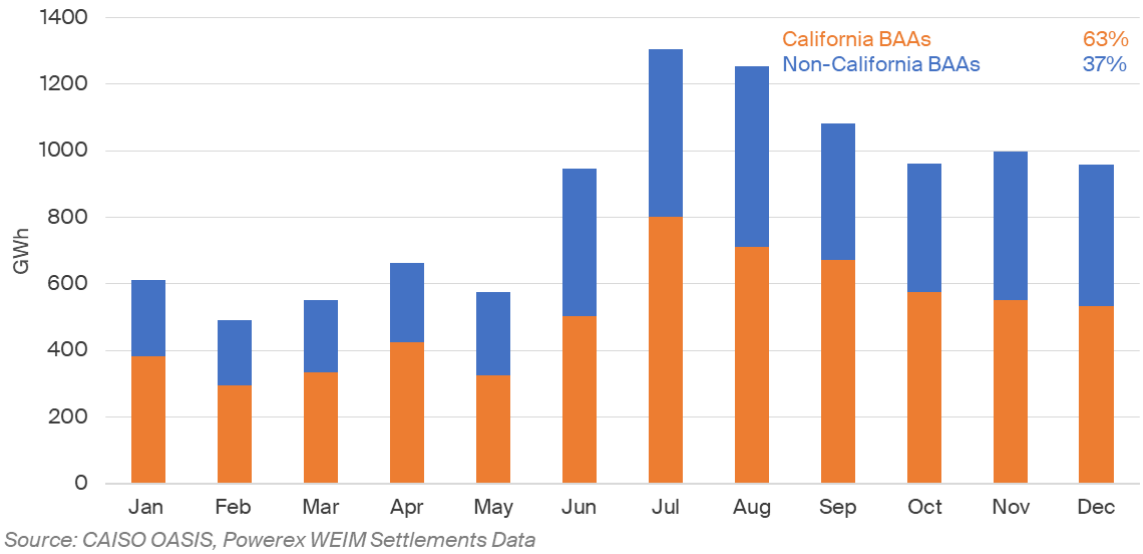
The analysis is presented as a series of questions, each of which is answered to the extent possible given available data.

1. When California Is Importing In The Western EIM, What Other BAAs Are Also Importing?

The CAISO publishes granular data on the imports and exports that occur as a result of Western EIM dispatch, as well as the quantity of "deemed deliveries", which, in aggregate, reflects the net imports into California in the applicable interval in the Western EIM.[7] This data can be used to identify when California is receiving imports in the Western EIM, and to determine the total quantity being imported in such intervals by California BAAs, and by non-California BAAs in the Western EIM.

[7] Imports into California are based on CAISO's reported volumes of "deemed deliveries." Imports into non-California BAAs are the difference between total Western EIM exports and the imports into California. Due to a recently identified CAISO implementation error, the annual quantity of "deemed deliveries" (6,110 GWh) differs from the quantity of published EIM transfers into California BAAs (5,405 GWh) in 2021.

Chart 4: Western EIM Imports When California Is Importing, 2021



Source: CAISO OASIS, Powerex WEIM Settlements Data

The most notable conclusions from the chart above are that *in the intervals that California is importing:*

1. California BAAs represent about 63% of all imports in the Western EIM.

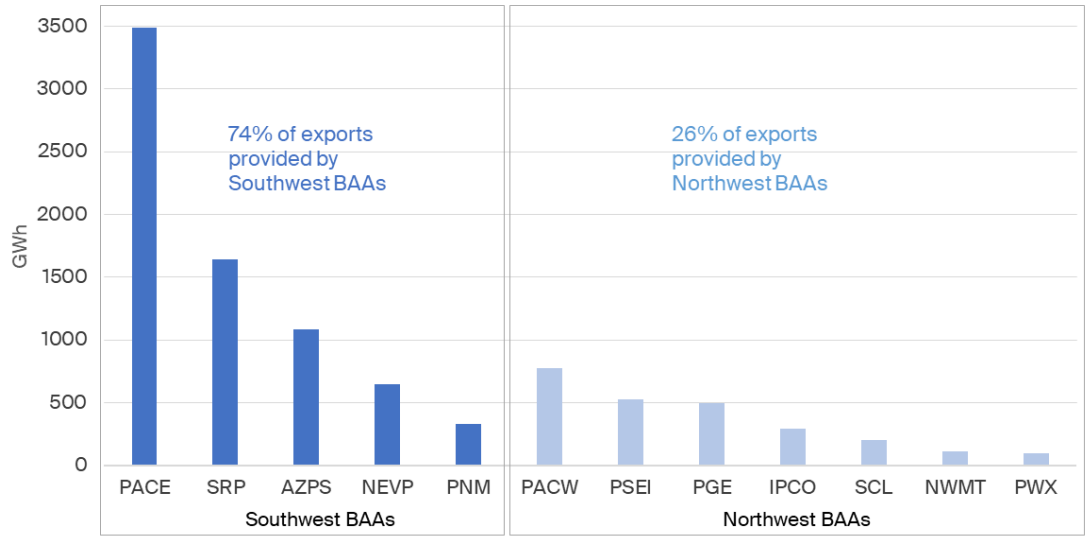
2. All of the non-California BAAs that are importing during these intervals represent only 37% of all imports in the Western EIM.

In other words, Western EIM trade activity—during the intervals that California is importing —is predominantly comprised of the rest of the west selling surplus electricity that is imported to serve load in California.

2. When California Is Importing In The Western EIM, Which Specific BAAs Are Exporting?

The same data on each BAAs net imports or net exports in each interval in the Western EIM can be used to determine the total quantity actually being *exported* in the Western EIM by each BAA, when California is receiving imports in the Western EIM.

Chart 5: Western EIM Exports By BAA When California Is Importing, 2021



Source: CAISO OASIS

The most notable conclusions from the chart above are that in the intervals that California is importing*:*

1. Southwest BAAs provided 74% of the electricity imported by other BAAs,

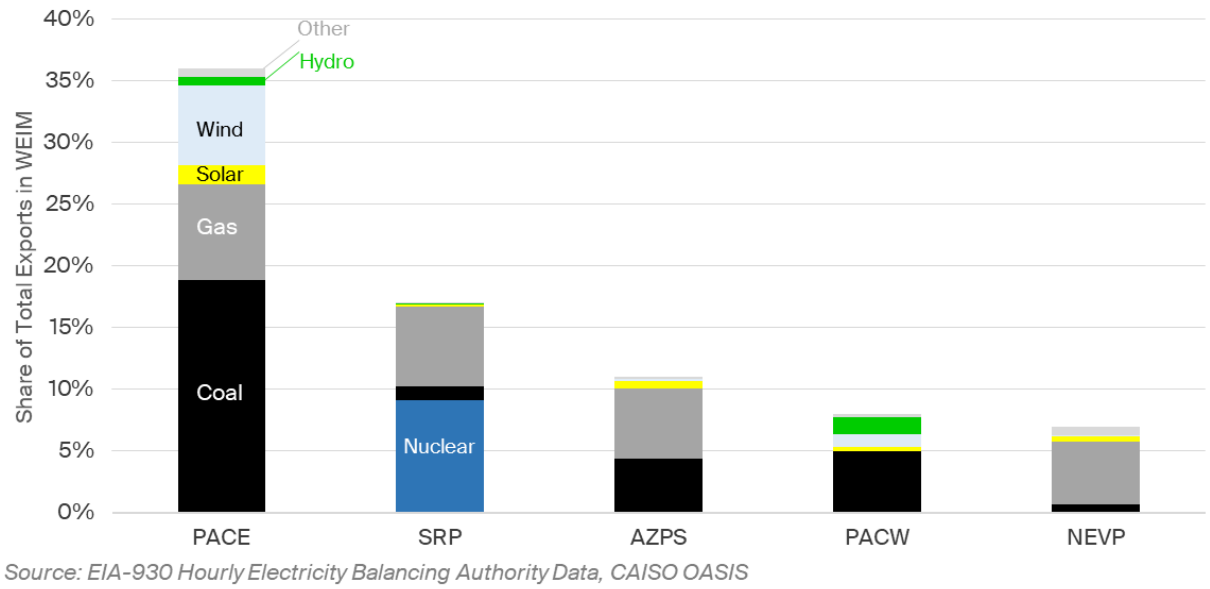
2. Northwest BAAs provided only 26% of the electricity imported by other BAAs,

3. The PacifiCorp East BAA was the largest supplier of the electricity imported by other BAAs, as it provided 36% of all BAA exports.

3. What Is The Fuel Type Mix In The BAAs That Are The Largest Exporters When California Is Importing?

The following chart shows the (volume-weighted) fuel type of the electricity produced in each of the top five exporting BAAs during those intervals that California was importing in the Western EIM, as reported to the Energy Information Administration (EIA).

Chart 6: Total Energy Production By Fuel Type Of Top Exporting BAAs When California Is Importing, 2021 (Scaled To BAA's Share Of All BAA Exports)



Source: EIA-930 Hourly Electricity Balancing Authority Data, CAISO OASIS

The most notable conclusions from the chart above are that *in the intervals that California is importing*:

1. The energy produced by the top five exporting BAAs is predominantly from fossil-fueled resources, with a large amount of coal and natural gas generation. The clean and low-emitting resources, while material, are a relatively smaller portion of the resources used to support their exports.

2. The total electricity produced in the largest exporting BAA, the PacifiCorp East BAA, is comprised of a relatively large amount of coal generation (approximately 53%), with the remainder of the electricity produced mostly by gas and wind resources.

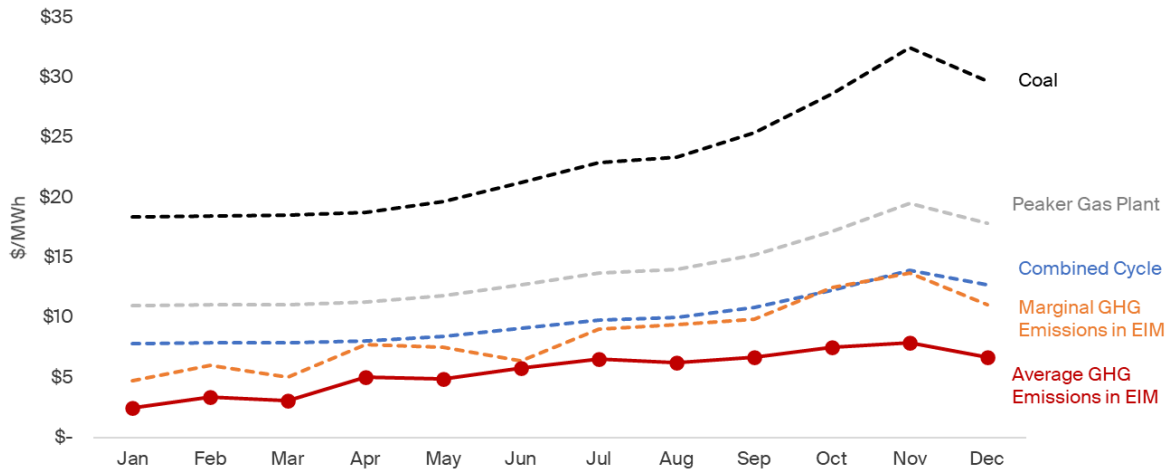
3. The majority of the electricity supply that is produced and exported from the top five exporting BAAs in the intervals that California is importing (which is generally the non-solar hours) is from GHG-emitting resources, which likely includes a considerable amount of electricity from coal-fired generation.

4. As a result, most of the electricity that is imported into California in the Western EIM is sourced from GHG-emitting resources, which likely includes a considerable amount of electricity sourced from coal-fired generation.

4. What Were The Marginal and Average GHG Emissions in the Western EIM In 2021 When California Was Importing?

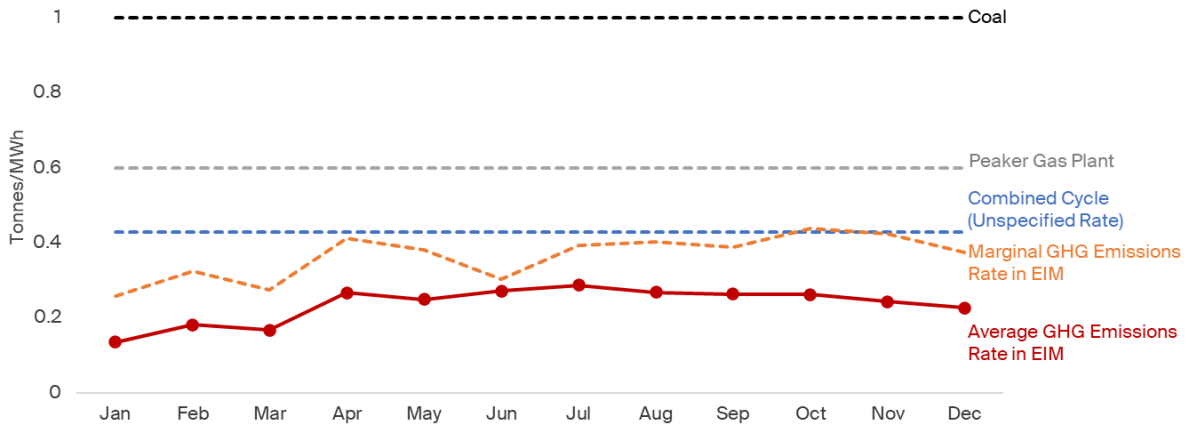
Prices in the Western EIM are comprised of discrete components, including a component for GHG costs, based on the GHG emissions of the marginal source of external supply being imported into California. Western EIM GHG prices during 2021 can be compared to the GHG emissions costs for different types of generating resources, calculated from the typical emissions rate for that type of resource and the prevailing price of GHG allowances.

Chart 7: Western EIM's Determination Of The Marginal and Average GHG Costs, 2021



Source: CAISO OASIS

Chart 8: Western EIM's Determination Of The Marginal And Average GHG Emissions Rate, 2021



Source: CAISO OASIS

The above two charts utilize a GHG-emissions rate of 0 tonnes/MWh for hydro, 0.43 tonnes/MWh for a combined cycle gas unit, 0.6 tonnes/MWh for a gas peaker, and 1.0 tonnes/MWh for a coal generator.

The most notable conclusions from the charts above are that when California is importing:

1. The Western EIM determined a marginal GHG-emissions rate applicable to imports, of 0.36 tonnes/MWh, on average.

2. This marginal rate is not only below the GHG-emissions rate of external coal generation (~1.0 tonnes/MWh) and external gas peakers (~0.6 tonnes/MWh), which are likely providing a considerable portion of the imported electricity to California, it is even below the GHG-emissions rate of a typical combined cycle generator (~0.43 tonnes/MWh).

3. The *average* GHG-emissions rate applied to those imports that are "deemed delivered' was well below this 0.36 tonnes/MWh, and is estimated at only about 0.25 tonnes/MWh in 2021, as explained on page 39.[8]

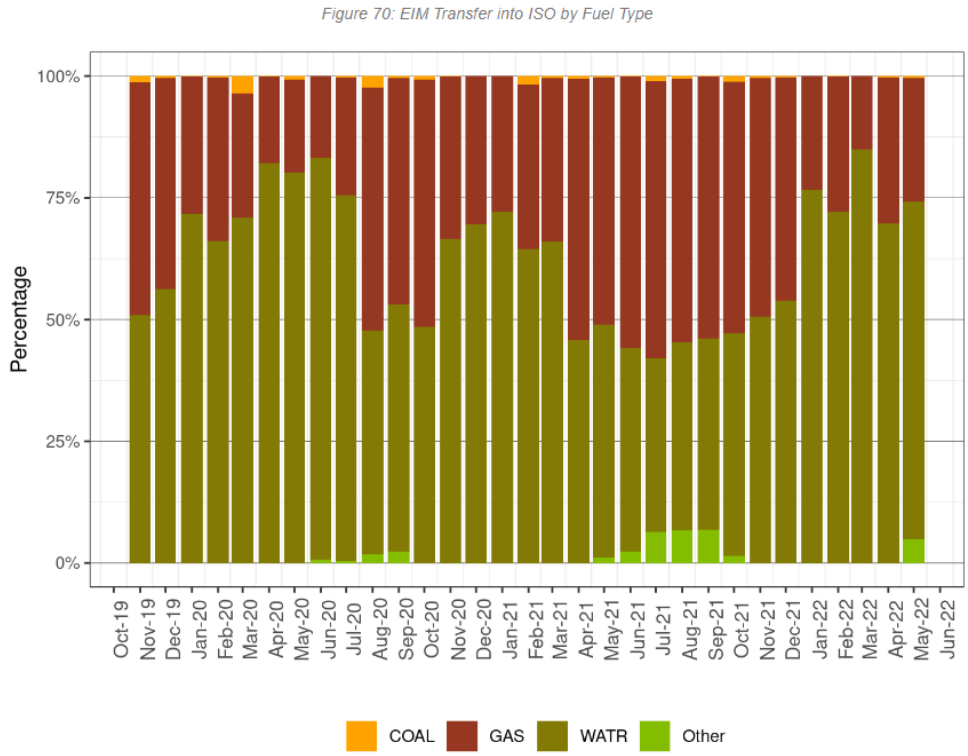
4. The GHG-emissions rate applied to California imports is clearly inaccurately low, as it does not reflect the fuel mix of the BAAs that are predominantly providing the electricity that is imported into California.

5. What Is The Fuel Mix That Is "Deemed" To Be The Specified-Sources Of Imports Into California In The Western EIM?

The CAISO publishes monthly reports on the quantity of Western EIM imports into California by the fuel type of the resources that were "deemed delivered."

[8] Powerex's estimate of 0.25 tonnes/MWh for 2021 is comparable to the average GHG-emissions rate applied to EIM imports in previous years which can be calculated using CAISO OASIS data and reported EIM Outstanding Emissions. For example, using such data, the calculated average GHG-emissions rate applied to EIM imports was 0.17 tonnes/MWh (2018), 0.28 tonnes/MWh (2019), and 0.21 tonnes/MWh (2020). EIM Outstanding Emissions can be found at https://ww2.arb.ca.gov/sites/default/files/2021-12/2018-2020compliancereport.xlsx

Chart 9: Western EIM's Determination Of The Source Of California Imports By Fuel Type



Source: CAISO Monthly Market Performance Report for May 2022, Fig. 70.

The most notable conclusions from the chart above are that:

1. During 2021, the Western EIM determined that 47% of California imports were sourced from hydro generation, with the remainder mostly sourced from natural gas generation (about 49%), with only a negligible amount sourced from coal (less than 1%) and other generation technologies (about 3%).

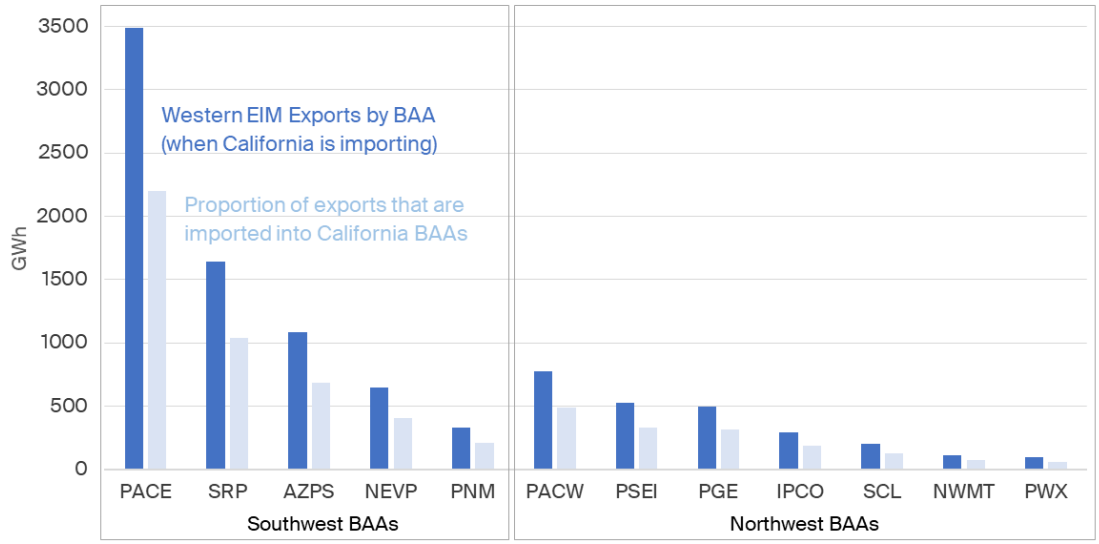
2. The Western EIM's determination of which resources supplied the electricity that is imported into California is completely inconsistent with the fuel mix of the BAAs that were the largest exporters when California was importing in 2021 (Chart 6 on page 28).

3. The Western EIM is systemically identifying the wrong external resources in its determination of the source of supply of the electricity imported into California, incorrectly identifying clean and lower-emitting resources when GHG-emitting resources are actually providing the supply.

6. *Which EIM BAAs Are Exporting When California Is Importing, And Which BAAs Are "Deemed" As The Source Of California Imports?*

The volume of imports that are "deemed delivered" from a particular BAA can be compared to the quantity of actual exports from that BAA when California was importing, and also to the portion of those actual exports that reflects the calculated quantity that is being imported into California. This requires accounting for the fact that most—but not all—imports in the Western EIM at such times are by California BAAs. For purposes of this analysis, each BAA's export quantity was scaled down by the ratio of total imports into California BAAs divided by the total imports into all BAAs. In reality, frequent transmission constraints between the Northwest and California can be expected to result in Southwest BAAs having a disproportionately higher amount of their exports—and Northwest BAAs having a disproportionately lower amount—serving California load.

Chart 10: Western EIM Exports By BAA When California Is Importing, 2021

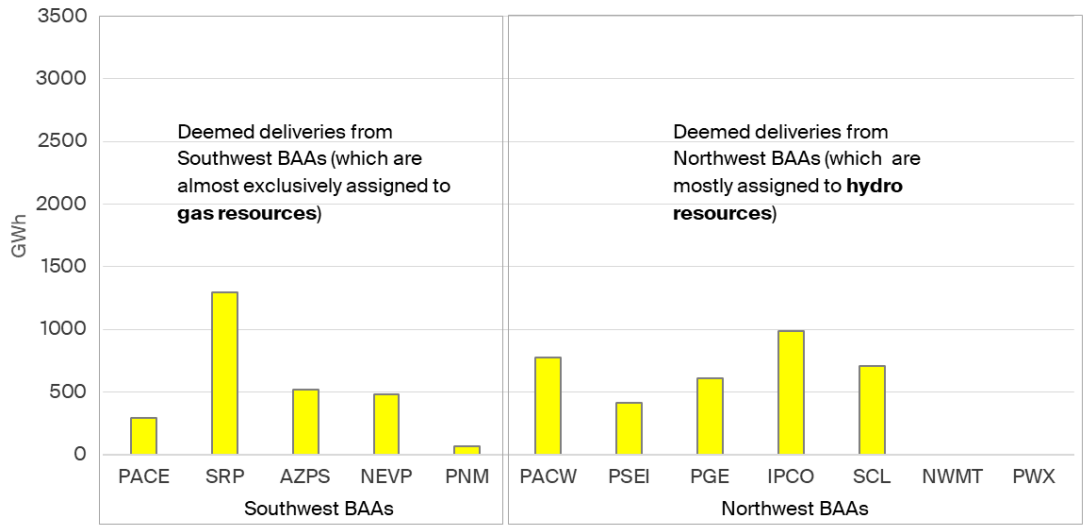


Source: CAISO OASIS

The volume of Western EIM exports from each BAA when California was importing can then be compared to the volume of each BAA's "deemed deliveries" to California.[9]

[9] This type of information has previously been published by DMM in its annual reports, and is also included in settlement data provided by the CAISO to Western EIM participants.

Chart 11: Western EIM Resources Deemed Delivered To California By Exporting BAA, 2021



Source: Volumes from Powerex WEIM Settlements Data

The most notable conclusions from the two charts above are:

1. There is no relationship in the Western EIM between the BAAs that are being deemed delivered to California and the BAAs that are actually exporting (during the intervals that those imports are occurring).

2. Southwest BAAs are providing most of the exports when California is importing (74%), but the resources in Northwest BAAs are being deemed as the source of most of the imports to California (57%).

3. The resources being deemed delivered in the Northwest BAAs must be mostly hydro resources, since about 47% of all "deemed deliveries" are "deemed" to come from hydro resources and the Southwest BAAs have a very limited amount of hydro resources.

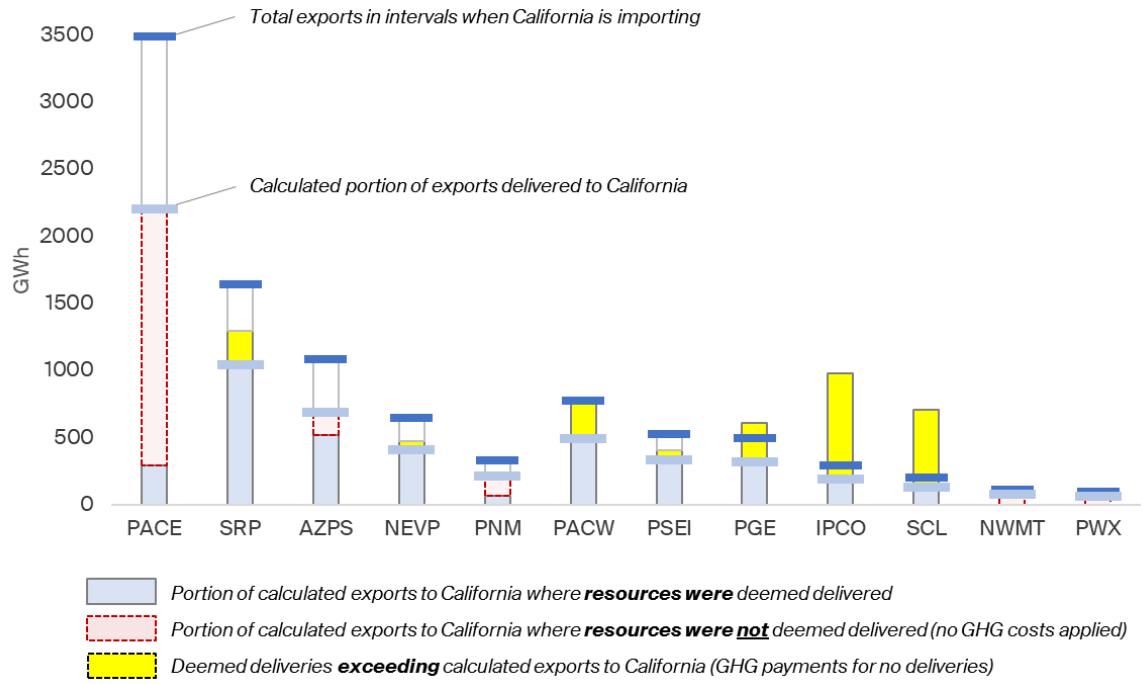
4. Similarly, the resources being deemed delivered in the Southwest BAAs must be (almost exclusively) gas resources (since about 49% of all "deemed deliveries" are "deemed" to come from gas resources and the resources being deemed delivered in Northwest BAAs are largely hydro resources).

7. How Do The BAAs That Are "Deemed Delivered" To California Compare To The BAAs That Are Actually Exporting When California Is Importing?

The different types of data presented above can be integrated into a direct comparison of the physical electricity exports in the Western EIM from a BAA to the "deemed deliveries" from that BAA. The chart below highlights BAAs where the portion of calculated exports to California

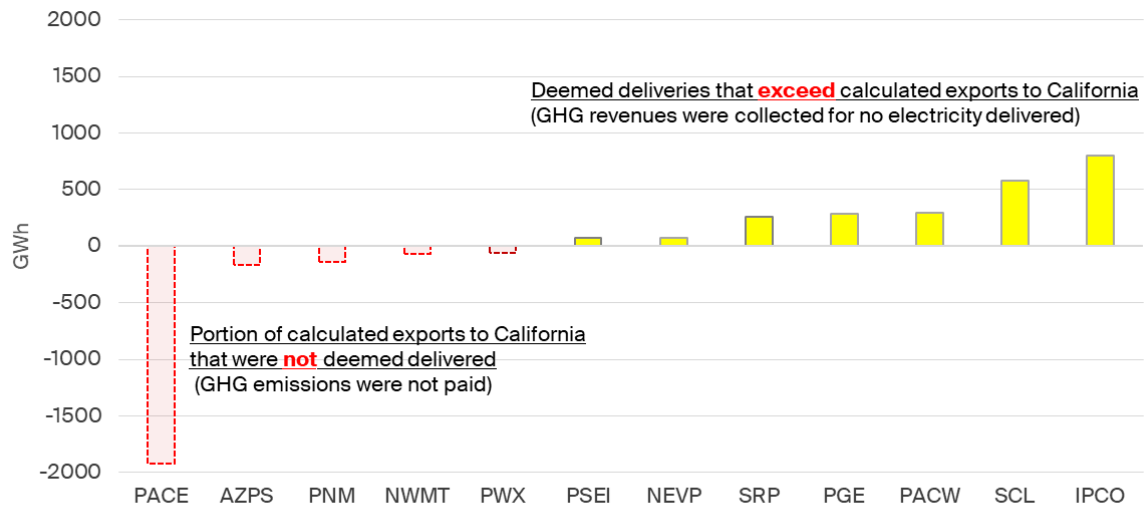
exceed “deemed deliveries” (red bars) and the BAAs with “deemed deliveries” that exceed their portion of calculated exports to California (yellow bars).

Chart 12: Analysis Of Western EIM Resources Deemed Delivered To California By Exporting BAA, 2021



The volumes that represent a mismatch between the portion of calculated exports to California and the “deemed deliveries” are isolated for each BAA, and presented below:

Chart 13: Analysis Of Western EIM BAAs With Excessive Or Insufficient Deemed Deliveries To California, 2021



Source: CAISO OASIS, Powerex WEIM Settlements Data

The most notable conclusions from the two charts above are that in the intervals that California is importing:

1. The PacifiCorp East BAA is providing the greatest amount of export supply, but resources in this BAA are not being deemed delivered to California sufficiently by the Western EIM's algorithm. Exports from the PacifiCorp East BAA totaled 3493 GWh during these intervals, and it is estimated that the resources in the PacifiCorp East BAA should have been deemed delivered to California for at least 2202 GWh (i.e., 63% of its exports, since "deemed" deliveries to California BAAs comprised 63% of all Western EIM imports during these intervals).[10] However, resources in the PacifiCorp East BAA were only deemed delivered 292 GWh. This represents an estimated understatement in the quantity of "deemed delivered" supply of 1910 GWh (an understatement of 87%). In other words, resources in this BAA are selling their supply, resulting in BAA exports and corresponding imports into California, but are not being required to report, or pay the costs associated with, their GHG emissions.

2. Four northwest BAAs, each with significant quantities of clean hydro generation, are being deemed delivered to California for a quantity that is not only greater than would be expected (based on an estimated 63% of their respective exports, in correspondence to the portion of total imports that are to California BAAs), but is also significantly greater than each of their respective total BAA exports in the Western EIM in these intervals. These four BAAs are the Idaho Power, PacifiCorp West, Portland General Electric, and Seattle City Light BAAs. Resources in these BAAs are being compensated (at the Western EIM's GHG shadow price) for being "deemed delivered" for quantities that are well in excess of any credible estimate of their production and delivery of electricity to California in the Western EIM.

3. Powerex participates in the Western EIM with supply sourced exclusively from clean hydro generation in British Columbia. It is not among the large Northwest hydro BAAs identified here as receiving compensation under the Western EIM's flawed application of California's Cap and Trade program, however, as a result of Powerex's election to not be deemed delivered to California. Powerex's decisions to make this election was based on its concerns regarding the Western EIM's flawed application of California's Cap and Trade Program.

8. How Much Value Are The Resources In The BAAs With The Largest Inaccuracies In Their GHG-Emissions Allocation Receiving?

Resources that participate in the Western EIM may receive two different types of benefit from the inaccuracy in the GHG framework. First, resources that are dispatched but are not reported

[10] It is important to note that this is a conservatively estimated quantity, considering that supply from the northwest BAAs during these intervals is often not deliverable to California, given transmission limitations (e.g., congestion on the Pacific AC Intertie).

as being imported into California avoid the GHG compliance costs that would otherwise apply. These resources effectively enjoy the ability to sell their output at wholesale market prices that reflect the GHG costs of California's in-state natural gas generators (which cannot avoid these costs since they are applied "at the smokestack"), while enjoying a competitive advantage over those internal resources since the Western EIM largely avoids recognizing the GHG emissions of high-emitting external resources.

The following table estimates the range of savings for the understated deliveries to California that were calculated from each BAA. The range of savings depends on the specific type of resource that is being dispatched, and its associated GHG emission rate. The blue shading indicates the prevailing resource types in each BAA.

Table 3: Estimated Savings Associated with Understated Deliveries to California (2021)

BAA	Understated Deliveries to California (GWh)	Range Of Estimated Savings (Dependent On Fuel Type Of Exported Electricity) ($Millions)			
		Hydro	*Combined Cycle*	*Gas Peaker*	*Coal*
PACE	(1910)	$0	**$25**	**$34**	**$57**
AZPS	(164)	$0	**$2**	**$3**	**$5**
PNM	(139)	$0	**$2**	**$3**	**$4**
NWMT	(71)	$0	**$1**	**$1**	**$2**
PWX	(59)	**$0**	$1	$1	$2

The second way in which some resources may benefit from inaccuracy in the Western EIM GHG framework is by receiving a GHG payment for being "deemed delivered" in excess of actual incremental electricity produced and delivered to California. Resources that are "deemed delivered" also incur a compliance cost depending on the GHG emissions rate of their resource (which is zero for non-emitting resources such as hydro). The table below shows a range of net benefit received by resources in each BAA, with the range reflecting the compliance cost associated with different resource types. The blue shading indicates the prevailing resource types in each BAA.

Table 4: Estimated Value of GHG Payments for Overstated "Deemed" Deliveries to California (2021)

BAA	Overstated "Deemed" Deliveries to California (GWh)	Range Of Estimated Excessive Payments (Dependent on Fuel Type Of Deemed Resources) ($Millions)		
		Hydro	Combined Cycle	Gas Peaker
IPCO	793	**$8**	($2)	($6)
SCL	577	**$6**	($1)	($4)
PACW	285	**$3**	($1)	($2)
PGE	292	**$3**	($1)	($2)
SRP	257	$3	**($1)**	**($2)**
PSEI	73	$1	**($0)**	**($1)**
NEVP	68	$1	**($0)**	**($1)**

The most notable conclusions from the charts above is that in the intervals that California is importing:

1. GHG-emitting resources in the PacifiCorp East BAA are estimated to have avoided between $25 million and $57 million in GHG costs associated with the Western EIM's flawed algorithm understating the portion of this BAA's exports that are imported into California. Costs avoided by GHG-emitting resources in other Southwest BAAs with understated imports to California are estimated to range from $1 million to $5 million, depending on the BAA and the fuel source of the supply.

2. Hydro resources in the Idaho Power, Seattle City Light, PacifiCorp West and Portland General BAAs are being excessively "deemed delivered" to California in the Western EIM, resulting in excessive payments that are estimated to range from $3 million to $8 million, with no associated GHG emissions costs (as hydro resources are clean).

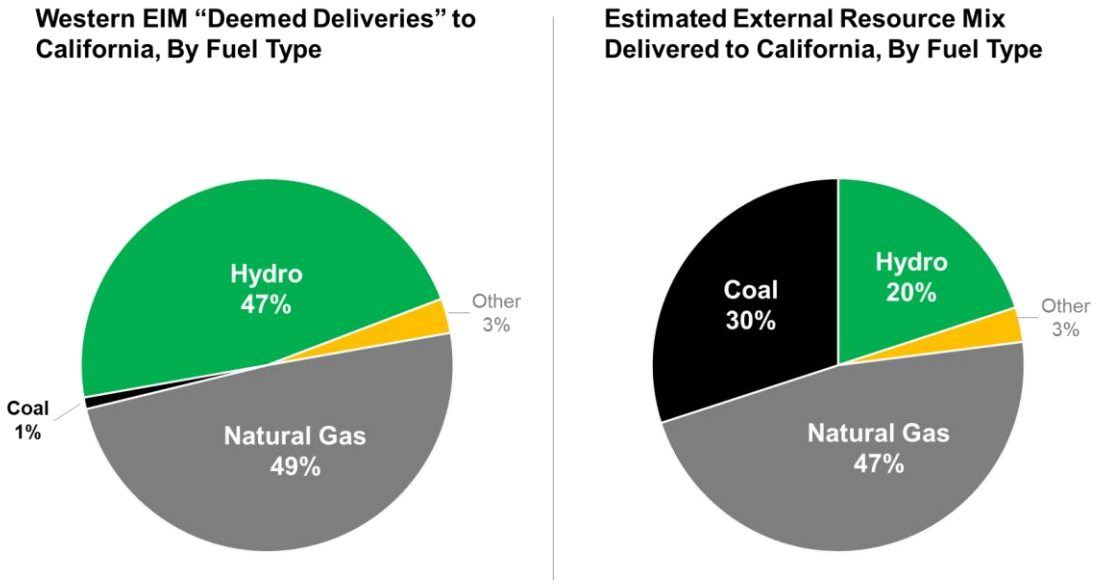
9. By How Much Are The GHG Emissions Associated With External Resources Serving California Load Being Understated?

Chart 9 shown on page 31 (CAISO Monthly Market Performance Report for May 2022, Fig.70), illustrates that during 2021, the Western EIM inaccurately determined that the external resources serving California load in the Western EIM were comprised of about 47% hydro resources, with the remainder mostly from natural gas resources.

The fuel type of the resources that are deemed delivered by the Western EIM algorithm can be compared to the fuel type of the resources that are incrementally dispatched in the Western EIM when California is importing. However, this data is available only to the CAISO (and to its DMM). For purposes of this analysis, the fuel type of the resources of BAAs that are exporting in the Western EIM when California is importing was calculated from available public data from the U.S. Energy Information Administration, together with reasonable assumptions. **Appendix 1** provides further explanation of the data and methodology used to estimate the fuel source mix of Western EIM exports when California was importing. Appendix 1 also recommends a more granular analysis that can be performed with non-public information available to the CAISO.

The figure below shows the stark difference between the fuel source mix of the resources that are "deemed delivered" and the estimated fuel source of the resources producing electricity in the BAAs that are exporting when California is importing in the Western EIM:

Illustration 9: "Deemed Deliveries" And Estimated External Resource Mix Delivered To California By Fuel Type, 2021



The difference between the two charts above reflects that the Western EIM algorithm "deems" hydro resources to be the source of California imports for a quantity that is far beyond the incremental hydro production in the Western EIM. This excessive deeming of hydro resources enables the algorithm to almost entirely avoid "deeming" coal resources as the source of California imports. Moreover, in some periods, the algorithm fully exhausts its ability to "deem" hydro resources (*i.e.,* there is no more hydro resources available and willing to be deemed as the source of California imports in the Western EIM), resulting in the algorithm excessively deeming natural gas resources (to further avoid deeming coal resources as the source of California imports).[11]

Utilizing the estimated actual fuel mix of external resources imported to serve California load, the following table sets forth an estimate of the actual GHG-emissions and associated costs of the external resources serving California load, and compares that to the "deemed" GHG-emissions and associated costs (that are being accounted for and collected from participants) in the Western EIM. It utilizes an estimated GHG allowance cost of $30/tonne, consistent with prevailing California Cap and Trade GHG allowance prices at the end of 2021:

[11] Conversely, if the algorithm fully avoids "deeming" coal resources and still has not exhausted its ability to "deem" imports from clean hydro resources, it will deem additional imports from hydro resources to avoid deeming imports from higher-emitting natural gas (*i.e.,* peaking units) and even efficient natural gas (*i.e.,* combined cycle) resources.

Table 5: Estimation Of Western EIM's Determination Of Average GHG Emissions Rate And Average GHG Costs Associated With California Imports, 2021

Resource Technology	Deemed Delivered (%)	GHG Emissions (Tonnes/MWh)	GHG Emissions Costs ($/MWh)
Hydro	47%	0	$0.00
Gas (Combined Cycle)	33%	0.43	$12.84
Gas (Gas Peaker)	16%	0.6	$18.00
Coal	1%	1	$30.00
Other	3%	0	$0.00
	100%	**0.25**	**$7.43**

Table 6: Estimations Of Actual Average GHG Emissions Rate And Average GHG Costs Associated With California Imports In The Western EIM, 2021

Resource Technology	Deemed Delivered (%)	GHG Emissions (Tonnes/MWh)	GHG Emissions Costs ($/MWh)
Hydro	20%	0	$0.00
Gas (Combined Cycle)	24%	0.43	$12.84
Gas (Gas Peaker)	23%	0.6	$18.00
Coal	30%	1	$30.00
Other	3%	0	$0.00
	100%	**0.54**	**$16.22**

The most notable conclusions from the charts and tables above are:

1. The external fuel mix serving California load in the Western EIM was predominantly fossil fueled generation (estimated to comprise 77% of the external supply), whereas the external fuel mix of the external resources that were "deemed delivered" to California by the Western EIM's algorithm included a much greater share of hydro generation (at about 47% of the external supply).

2. Hydro generation was excessively "deemed delivered" (47% deemed vs an estimated 20% of California imports), enabling the dispatch and delivery of coal resources that are not "deemed delivered" (less than 1% deemed vs an estimated 30% of California imports) and gas peakers that are not "deemed delivered" (16% deemed vs an estimated 23% of California imports), with the associated resource owners/sellers avoiding the costs associated with their GHG emissions.

3. The GHG emissions rate associated with external resources that served California load in the Western EIM is estimated at 0.54 tonnes/MWh, whereas the Western EIM only calculated, and required the reporting of, an estimated 0.25 tonnes/MWh of imports (about 46% of the estimated GHG emissions).

4. The GHG emissions costs collected from owners/sellers of external resources serving California load in the Western EIM, at the prevailing market price of $30/tonne for California GHG allowances, was only about $7.43/MWh, whereas it is estimated that the actual cost was more than double that amount at an estimated $16.22/MWh.

Appendix 3 discusses the harmful consequences of this extensive leakage, which are neither efficiently or adequately mitigated by the retirement of additional GHG allowances.

Conclusions And Next Steps

The Western EIM design can aptly be characterized as automating resource shuffling, dispatching coal and other high-emitting resources to serve California demand while labeling it as clean hydro supply. The Western EIM does not—and by design, cannot—accurately incorporate the GHG emissions of external resources that produce additional electricity to enable imports into California. The harmful consequences of the Western EIM's "deeming" approach may be limited by the comparatively small volume of transactions that occurs through the Western EIM, but, as explained below, replacing the "deeming" approach with a more accurate GHG attribution framework is urgently needed.

The following actions are recommended as concrete steps toward an accurate GHG framework for the Western EIM that could be taken by CARB, perhaps in concert with other state agencies that oversee planned or potential GHG-pricing programs in the west:

1. Request that CAISO perform an analysis based on its internal data on Western EIM operations, as discussed in **Appendix 1**.
2. Convene a workshop, or series of workshops, to:
    a. Examine the design and performance of the Western EIM "deeming" algorithm, including a discussion of the findings of this paper; and
    b. Explore the changes necessary for the Western EIM to accurately account for GHG emissions of external resources serving California load.

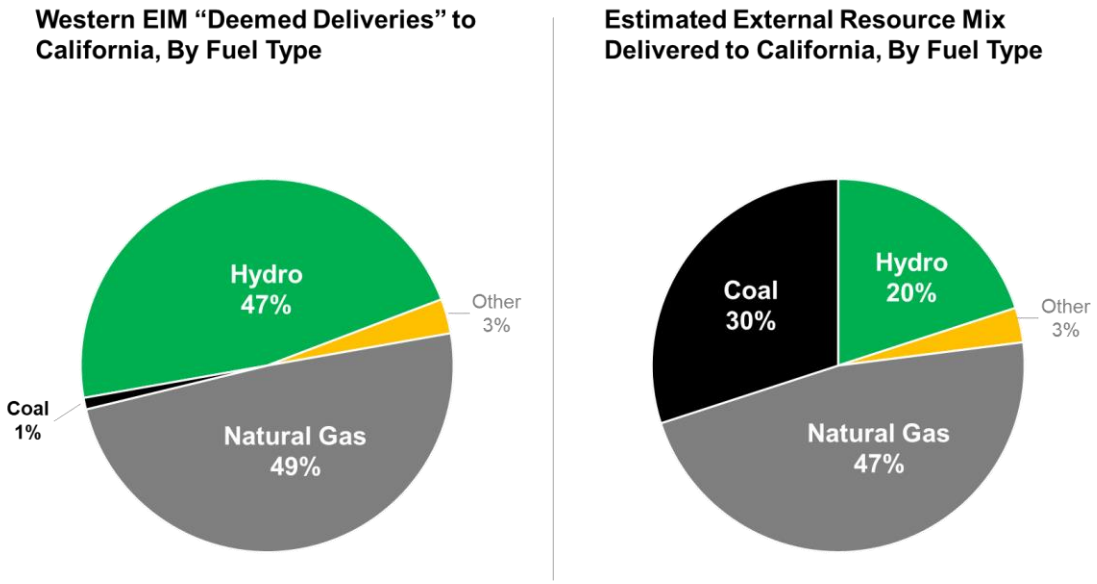
Importantly, the need for a more accurate GHG framework goes well beyond the Western EIM, as organized wholesale electricity markets are poised to expand in the west to the day-ahead timeframe. One of the two day-ahead organized market platforms currently under development (CAISO's Extended Day Ahead Market or EDAM) proposes to apply the Western EIM's "deeming" approach, with only minor modifications. This would greatly exacerbate the harmful consequences of the "deeming" approach, as it would be applied to the far greater volume of imports that are arranged in the day-ahead timeframe.

CARB, and other agencies that oversee state environmental policy and programs in the west, will likely need to increase their participation in ongoing western market design initiatives if the goals of these programs are to be achieved. These are arguably the only state entities that can adequately and fully represent state environmental policy goals, as these goals are likely to be in tension with the interests of other stakeholders, agencies, and institutions involved in the market design process. It will also be necessary for entities with clean resources—including not just renewables and hydro utilities with surplus energy, but also battery storage and demand response programs—to be actively engaged in ensuring wholesale organized markets accurately reflect the value of their clean supply.

Appendix 1: CAISO Should Provide Greater Transparency Regarding The Clear Flaws In Western EIM's GHG Framework

The analysis includes a comparison between the fuel mix of the imported electricity that the Western EIM GHG "deems delivered" to California (shown at left, below), and the estimated fuel mix of the electricity production in the BAAs that are exporting in the Western EIM in the intervals that California is importing (shown at right, below).

Illustration A-1: "Deemed Deliveries" And Estimated External Resource Mix Delivered To California By Fuel Type, 2021



The CAISO publishes regular reports on the fuel mix of the resources that are "deemed delivered" to California in the Western EIM. These reports provide the basis for the left-hand chart, and for estimates of the average GHG emissions of the resources that are "deemed delivered."

There is no comparably granular information published by the CAISO regarding the fuel mix of the resources that are incrementally dispatched in the Western EIM (*i.e.,* the resources that produce additional electricity, over and above their self-determined base scheduled output). Incremental production can be estimated, however, by examining the quantity of electricity produced from each exporting BAA in the Western EIM in the periods that California is importing. This provides a starting point for estimating the fuel mix of the resources that increase production in the Western EIM, as the fuel mix of the resources in each exporting BAA is also known in each applicable hour, as it is reported to the Energy Information Administration (EIA). More specific details on the approach used for estimating the fuel mix shown above in Illustration A-1, are as follows:

- **Hydro (20%):** Northwest BAAs account for 26% of the total Western EIM BAA exports when California is importing. Almost all hydro generation participating in the Western EIM is located in Northwest BAAs, but these BAAs also include a material amount of

non-hydro resources (including coal and natural gas resources). It is therefore estimated that hydro resources are the source for about 75% to 80% of electricity exports from Northwest BAAs, resulting in hydro resources comprising an estimated 20% of the total BAA exports in the Western EIM when California is importing.

- **Coal (30%):** Based on EIA hourly production data, it is estimated that coal resources account for approximately 40% of the dispatchable electricity production from the (mostly Southwest) BAAs that produce the largest volume of exports in the Western EIM when California is importing (see Chart 6 on Page 28). The combined volume of exports from those BAAs reflects over 75% of all exports in the Western EIM during those intervals that California is importing. As a result, coal resources can be estimated to comprise approximately 30% of BAA exports (i.e., 40% x 75%), when California is importing in the Western EIM.
- **Other (3%):** This is the same value as in the CAISO's "deeming" report. It is understood that these likely represent renewable resources, which will be "deemed" to the greatest extent possible. The "deemed" value is used as a very conservative estimate (as it is the upper bound on the increased electricity production from these resources in the Western EIM).
- **Natural Gas (47%):** The remainder that is not accounted for in the above is assumed to be natural gas generation resources. This is slightly less than the total "deemed deliveries" (49%), which is consistent with the Western EIM's algorithm design which avoids "deeming" the highest GHG-emitting resources (i.e., coal) to the maximum extent possible, causing it to inaccurately deem external gas resources as the source of California imports when it exhausts its ability to deem clean resources. This category is further divided between natural gas combined cycle units and natural gas peaking units, as follows:
    - Total increased production from natural gas resources (47%) is assumed to be roughly equally divided between combined cycle units (24%) and peaking units (23%), as the latter are known to routinely operate in the morning and evening peak hours to support California's capacity and ramping challenges.
    - Deemed deliveries (49%) are assumed to be allocated preferentially to combined cycle gas units over gas peaking units, in a two-to-one ratio. This reflects that the Western EIM's algorithm avoids "deeming" higher-emitting resources, causing it to preferentially deem combined cycle gas units ahead of gas peaking units. This results in an estimate that 33% of imports were "deemed" to be from natural gas combined cycle resources, while only 16% were estimated to be "deemed" from natural gas peaking units.

The above approach is grounded on reasonable assumptions given the known fuel mix of resources operating in exporting BAAs when California was importing. Nevertheless, data that directly identified the incremental electricity production for each resource in the Western EIM would eliminate the need for any assumptions to be made. Such data is not available publicly or to Western EIM participants, but it is readily available to the CAISO and to its Department of Market Monitoring (DMM). All stakeholders' understanding of the Western EIM's GHG

"deeming" framework would benefit from the CAISO or DMM performing a similar analysis using the more granular data at their disposal.

More specifically, resource-level Western EIM data that can readily be used to perform such an analysis as follows:

1. Identify each interval in which California was a net importer in the Western EIM during 2021;
2. In each such interval, calculate the positive incremental output (above base schedules) for each resource in each EIM BAA that was a net exporter in the Western EIM;
3. Sum all of the positive incremental output quantities by each resource fuel type (*i.e.,* hydro, natural gas combined cycle, natural gas peaker, coal, renewable, and other);
4. Show each resource fuel type's share of positive incremental output from net exporting BAAs during each the intervals identified in Step 1, above;
5. Calculate the weighted average fuel mix for 2021, by weighting the fuel mix in each interval in Step 4, above, by the quantity of California imports in that interval.

The results of CAISO's analysis should provide a direct comparison to the chart above. The results should also be used to update Table 6 on page 39 of the paper, and to provide a more precise calculation of the average GHG emissions factor of the resources that were incrementally dispatched in exporting EIM BAAs during intervals that California was receiving imports. Any additional tables and figures contained herein that rely on available public data, but where CAISO has access to more granular or specific data, should also be revised as part of this transparency effort.

While the analysis of this paper focuses on 2021, it is notable that 2021 reflected dry conditions in the Northwest, with the Columbia River Water Supply for April to August 2021 representing only 83% of normal conditions. These dry Northwest hydro conditions likely limited the ability for the algorithm to further "deem" deliveries to California in the Western EIM to be sourced from hydro resources during this year.

Consistent with this hypothesis, a high-level review of a longer period from January 2020 to May 2022 shows that:

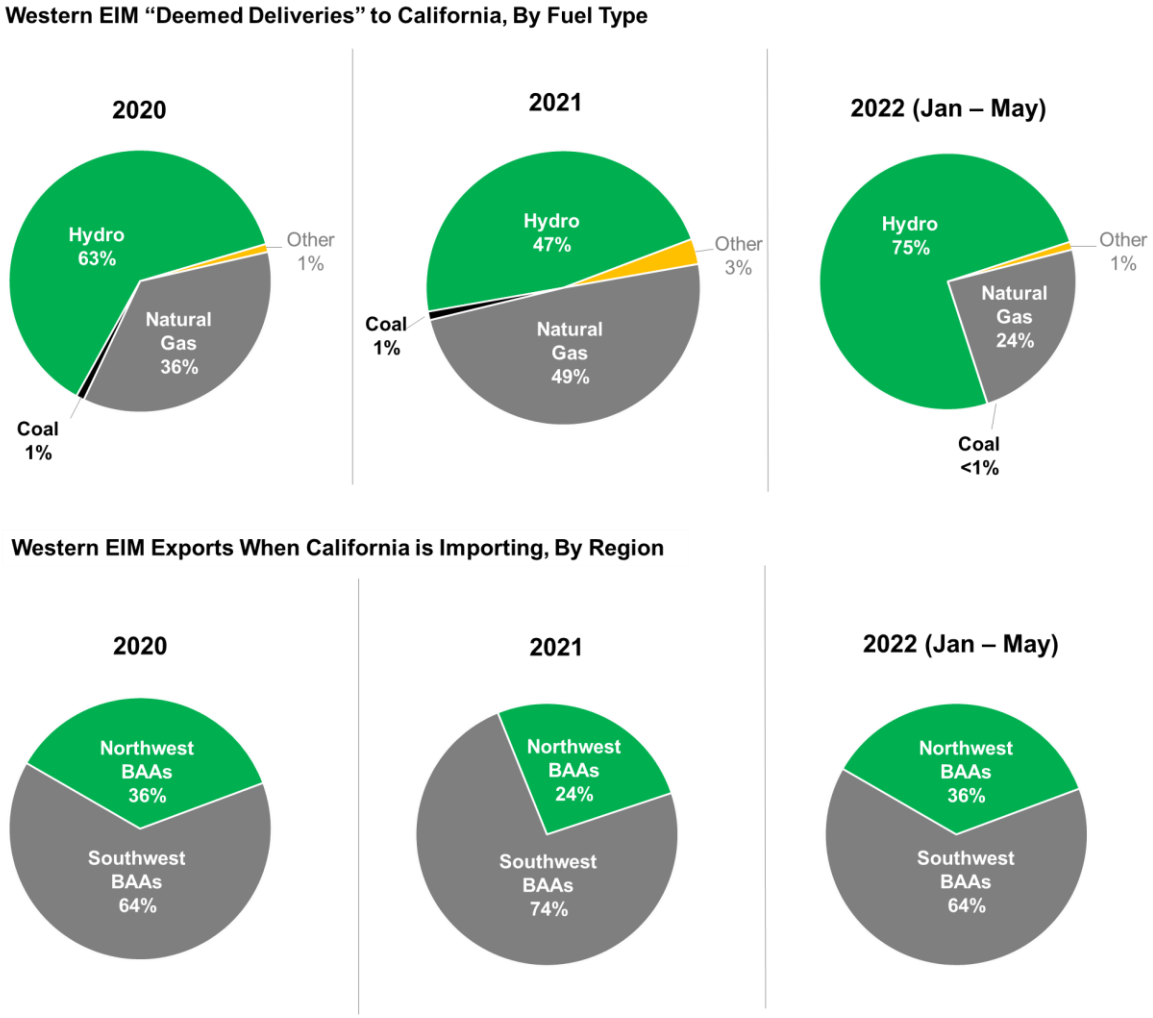
1. The share of total exports sourced from the Northwest (when California was importing) was only 26% in 2021, when the water supply was well below average. In contrast, in 2020, and in the first several months of 2022, the share of exports from the Northwest was moderately higher at 36% (when hydro conditions have been moderately above average).

2. While the share of exports from the Northwest has been within a relatively limited range across 2020, 2021, and the start of 2022 (26% to 36%), the range of deemed deliveries from hydro resources was much wider. Specifically, the total share of deemed deliveries from hydro resources was 63% in 2020, and 75% in the first five months of 2022, compared to 47% in 2021. In other words, the excessive deeming of "hydro" appears to

be even worse in 2020 and 2022 (year-to-date), as it was partially muted in 2021 by the dry hydro conditions in the Northwest.

These results are summarized below:

Illustration A-2: "Deemed Deliveries" by Fuel Type and Exports When California is Importing, By Region



Appendix 2: CARB's Retirement Of Additional GHG Allowances Is Not Sufficient, And Does Not Prevent The Harm Caused By The Western EIM's Flawed Approach To Applying California's Cap and Trade Program

Resources that are "deemed delivered" to California by the Western EIM software incur a reporting and compliance obligation to CARB based on the resource's specific GHG emissions. CARB, however, has recognized that the Western EIM GHG framework does not accurately identify the GHG emissions associated with Western EIM imports, as a result of the well-known "secondary dispatch" issue. In order to address the leakage that arises from this secondary dispatch issue, CARB has retired additional GHG allowances, with the additional quantity calculated from the difference between the reported GHG emissions and CARB's unspecified rate of 0.428 tonnes/MWh. In other words, CARB appears to view the "unspecified emissions rate … as the 'true' emissions profile of EIM imports."[12]

CARB's approach was developed as a necessary stop-gap measure once it became evident that the secondary dispatch issue was resulting in material leakage. However, this paper makes clear that the leakage in the Western EIM extends well beyond the secondary dispatch issue to a primary dispatch issue, causing additional leakage as well as numerous harmful consequences that are not addressed by CARB's current approach of retiring additional GHG allowances (and doing so based on the unspecified rate of 0.428 tonnes/MWh).

First, the volume of additional GHG allowances being retired is likely too low, and hence is not fully accounting for the leakage that is occurring. As explained under Question 9 on pages 37 – 40, the available public data suggests that the average GHG emissions of the resources that are dispatched to produce additional electricity when California imports in the Western EIM is approximately 0.54 tonnes/MWh, or nearly 25% higher than the rate that CARB uses as the "true" emissions of EIM imports. The more granular analysis requested to be performed by CAISO using data at its disposal (see Appendix 1) can more precisely calculate the remaining unaccounted for GHG emissions and associated leakage.

Second, even if the quantity of additional GHG emissions is accurately calculated, this approach merely shifts the burden of offsetting these excessive GHG emissions to other sectors of the economy. This subverts one of the major benefits of using a cap-and-trade program, which is to allow GHG emissions to be reduced in the sectors and through the activity that can achieve those reductions at the lowest cost. Arguably the most cost-effective strategy for reducing GHG emissions is to shift electricity production from high-emitting coal and natural gas generators to lower-emitting and non-emitting resources.[13] But rather than maximizing the substitution of

[12] CARB Independent Emissions Advisory Committee, "Report on Emissions Leakage and Resource Shuffling," (September 2018) at 8. (link)

[13] According to the U.S. EPA, the largest GHG reductions in the U.S. since 1990 have occurred in the electricity sector, and the primary driver of these reductions has been "a ***continued shift from coal to less carbon-intensive natural gas and renewables***." *See* U.S. EPA, "Source of Greenhouse Gas Emissions," (link)

higher-emitting generation with lower-emitting resources—and thereby capturing what is likely the "lowest hanging fruit" across all industries for meeting GHG targets—the Western EIM is doing the exact opposite when California is importing. This is not just a squandered opportunity to achieve GHG reductions at low cost, it also forces additional GHG emissions to be reduced in other sectors, where such reductions can be far more costly to achieve. What is needed is not merely to accurately tally the damage of excess GHG emissions caused by the Western EIM and to offset that damage elsewhere, but to stop that damage from occurring in the first place.

Third, the Western EIM's inaccurate "deeming" approach has additional consequences due to its failure to accurately reflect the cost of GHG emissions in wholesale electricity prices, and its failure to assign the costs of GHG emissions with the entities responsible for those emissions. The collateral damage of the "deeming" approach include:

- Reduced incentives for entities to invest in new clean and renewable resources;
- Missing price signals that would indicate (and help drive the selection of) the specific type of new clean and renewable resources that would have the greatest ability to displace higher-emitting resources, and achieve the greatest GHG reductions;
- A lack of price signals for external coal and inefficient natural gas plants to stop producing electricity that displaces more efficient in-state natural gas resources;
- A failure to charge GHG costs to the specific entities that emit GHGs to produce electricity that is imported into California; and
- Providing compensation to clean resources willing to be reported as the source of "deemed deliveries," but that do not produce and deliver electricity to California.

Properly applying a GHG-pricing program to the wholesale electricity sector can result in a very powerful mechanism for reducing GHG emissions, which cannot be achieved by any other type of program, including renewable or clean energy procurement programs. A GHG-pricing program can achieve what are arguably the most cost-effective GHG reductions available in any sector of the economy: shifting the production of electricity away from coal and inefficient natural gas resources to more efficient natural gas and renewable resources. Procurement programs are effective in driving the expansion of new resources, but a GHG-pricing program is the critical complement that drives both the optimal selection of those new resources and the optimal use of all installed and available resources.

A framework that properly applies a GHG-pricing program to an organized market must achieve the following (as applied to the applicable jurisdiction):

1. Provide accurate price signals, by increasing wholesale electricity market prices to reflect the cost of GHG emissions of producing electricity;
2. Require electricity producers to bear the cost of their GHG emissions when their electricity is imported into a GHG program's jurisdiction;
3. Provide additional compensation to entities that produce and deliver electricity from clean and low-emitting resources;

4. Where the specific resource producing electricity that is imported into a GHG program jurisdiction cannot accurately be identified, the import must be subject to a default GHG emission rate determined by the agency that administers the GHG program;
5. Avoid providing GHG-related compensation to entities that do not demonstrably produce additional electricity that is delivered to the applicable GHG program's jurisdiction;

Appendix 4 describes a proposal under advanced development in workshops related to a regional organized electricity market. The key barrier to accurate GHG pricing in the Western EIM (and any other organized wholesale electricity market) is *no longer* a technical one, but rather the need to see and move past the interests that benefit from the Western EIM's inaccurate "deeming" approach. While it may be relatively straightforward to identify and discount any opposition from entities with external resources that are currently benefiting from the "deeming" approach, it may be more challenging to overcome the in-state interests that continue to support and defend the *status quo,* particularly California load-serving interests. As California loads are typically large net purchasers of wholesale electricity, from both in-state and out-of-state suppliers, some of these load interests have a long history of supporting market design choices that minimize wholesale market prices. This puts them in direct conflict with one of the key goals of any GHG-pricing program, which is to provide more accurate price signals by *increasing wholesale prices* when GHG-emitting resources are the marginal source of supply. Accurate application of GHG-pricing programs to organized wholesale electricity markets can be achieved, but it will require active and committed leadership by environmental policy makers, with healthy skepticism of arguments to largely maintain the status quo.

Appendix 3: Renewable Resource Owners And Hydro Utilities With Surplus Clean Supply Need To Be In An Organized Market That Accurately Applies GHG-Pricing Programs

Among the resources in the western interconnection, the ones with the greatest ability to help achieve the region's decarbonization goals are renewable resources, battery storage, demand response and hydroelectric resources (particularly those hydroelectric resources with material energy surpluses). Each of these resource types can directly displace electricity production from the least efficient, highest GHG-emitting fossil fueled generation, and thereby achieve the greatest GHG reductions in the region.

But these are also the resources most disadvantaged by the Western EIM's inaccurate "deeming" framework. More specifically, entities that own and/or sell the output of these resources experience two types of harmful consequences under the "deeming" approach:

1. **Reduced dispatch:** when the Western EIM dispatches coal and inefficient natural gas resources that would not be economic if the cost of their GHG emissions was accurately accounted for; and
2. **Reduced compensation:** the sales of clean supply that do occur receive suppressed compensation, since the cost of GHG emissions is inaccurately low, resulting in suppressed wholesale electricity prices.

Entities with surplus clean supply will fail to receive full value for their supply unless they are in an organized wholesale electricity market with accurate GHG pricing. Accurate GHG pricing can be achieved by pursuing changes to existing markets, such as the Western EIM, and/or by developing new organized markets that seek to meaningfully apply the rules and meet the goals of GHG-pricing programs (rather than seeking to minimize the cost of compliance through novel approaches to market design). Ultimately, accurate GHG pricing will ensure that entities with surplus clean supply are compensated for reducing GHG emissions at prices that accurately reflects the applicable program's rules, without those benefits being eroded either by GHG-emitting resource that bypass the intended GHG emissions costs of the program or by entities that can claim to provide clean supply despite not actually producing and/or delivering it to the GHG program jurisdiction.

Appendix 4: Powerex and Public Generating Pool's Zonal Approach To Applying GHG-Pricing Programs In Organized Markets Is Far Superior To The Western EIM's Flawed "Deeming" Approach

An alternative approach to applying GHG-pricing programs to organized markets is the "Zonal GHG Framework" recently developed by Powerex and Public Generating Pool. The Zonal GHG Framework abandons the fiction of specified-source "deemed deliveries" utilized in the Western EIM, in favor of a much more accurate and robust approach to applying GHG-pricing programs to imports into the applicable GHG-pricing program jurisdiction(s).

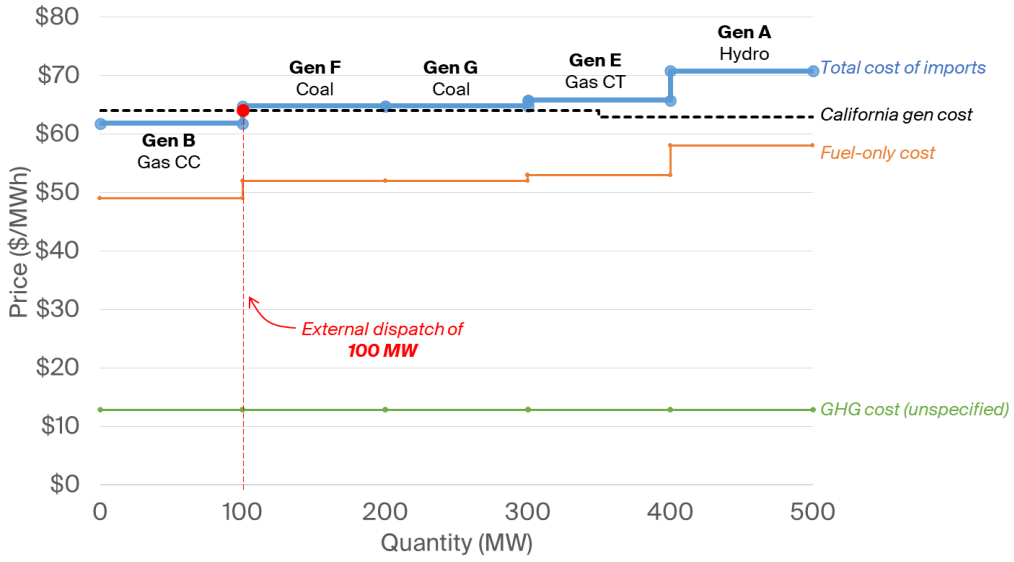
The Zonal GHG Framework requires, as a default mechanism, that all electricity imports into a GHG program jurisdiction be subject to the applicable program's defined hurdle rate for "unspecified source" imports (*e.g.*, 0.428 tonnes/MWh for California). While there may be instances in which electricity is produced by external resources with GHG emission rates higher than the unspecified rate, the potential for leakage is dramatically less under this approach than under the "deeming" approach, which very frequently applies *no GHG emissions costs at all* to imports of electricity produced by external fossil-fueled resources.[14]

Under the Zonal GHG Framework, resources with a GHG emission rate that is less than the unspecified rate would also have the opportunity to deliver their output into a GHG program jurisdiction as a "specified source" import. However, in contrast to the Western EIM, "specified source" eligibility would not be automatic. Resources would be required to meet reasonable but robust requirements for "specified source" deliveries, including demonstrating that the specific resource increased electricity production, and that transmission was available and arranged to deliver the resource's incremental output to the GHG program's jurisdiction. Critically, the Zonal GHG Framework would ensure that the resource's <u>own</u> GHG emissions are considered when evaluating whether such a specified-source import is economic, and also for associated reporting and compliance obligations (*i.e.*, GHG costs).

The effectiveness of the Zonal GHG Framework is demonstrated by examining how it would solve the hypothetical example discussed in this paper starting on page 12. First, consider the scenario in which none of the external resources elect to deliver their output as specified-source imports. In this scenario, external resources are dispatched solely on the basis of their fuel cost. Critically, however, all imports into California are subject to the same hurdle rate, based on the unspecified rate determined by CARB (0.428 tonnes/MWh). Using an assumed GHG allowance cost of $30/tonne, this hurdle rate would be about $13/MWh. The supply stack under this scenario is shown below:

[14] An improvement to the Zonal GHG Framework could be achieved through the utilization of granular operational data from the market operator to enable the GHG program regulator (*e.g.,* CARB) to refine and shape the unspecified rate to more accurately estimate GHG emissions under different conditions. For instance, CARB could apply a higher unspecified rate (*e.g.,* 0.6 tonnes/MWh) during the morning and evening peak hours, when less-efficient natural gas peaking units are known to frequently be dispatched in the west.

Illustration A-3: Supply Stack Based On Resource-Specific Fuel Cost And Unspecified Rate For Imports



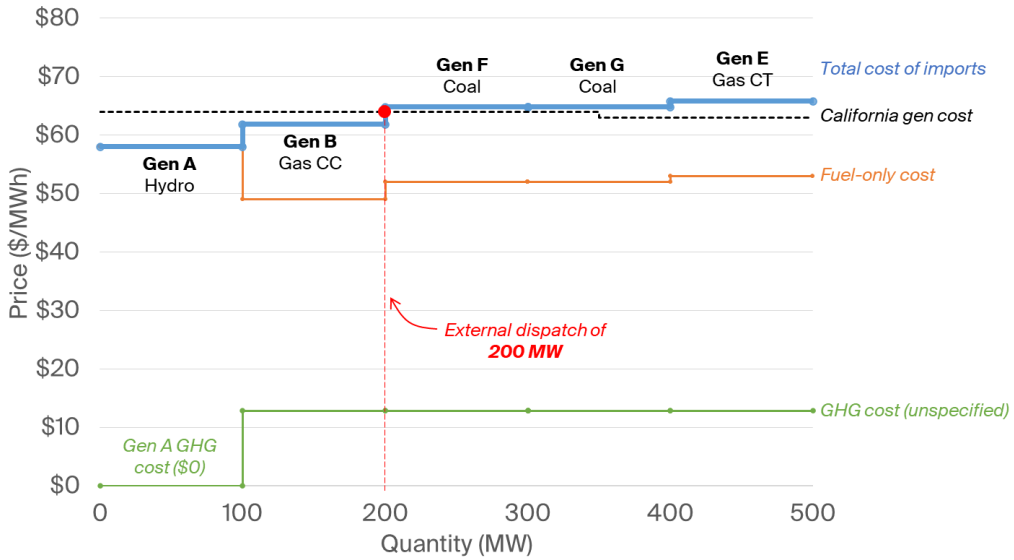
Critically, the resources with the lowest fuel cost (*i.e.,* natural gas-fired Generator B and coal-fired Generators F and G) no longer face a hurdle rate of $0 or $1, as they do under the Western EIM's current "deeming" approach. Instead, these resources—like all other external resources—face a hurdle rate of $13/MWh for their dispatch and delivery to California.

The application of a hurdle rate based on the unspecified emission rate results in 100MW of additional electricity production from external Generator B. The total cost of this import is comprised of the fuel-only cost for Generator B ($49/MWh) plus the unspecified GHG hurdle rate ($13/MWh), for a total supply cost of $62/MWh. This import is economic to displace 100MW of production from California Generator 2, since it's total cost (including GHG costs) is $64/MWh. There are no additional opportunities for economic displacement by external generators, since the next increment of imported supply costs $65/MWh, which exceeds the savings from further reducing the output from California Generator 2.

Notably, this solution avoids the most problematic outcomes under the Western EIM's "deeming" approach, in which external coal was dispatched to displace in-state natural gas generation. It should be noted that, in practice, a uniform unspecified rate may still result in the dispatch of coal and other higher-emitting resources to serve California load in certain circumstances (*i.e.*, if the difference between the fuel-only offer price of an external resource and the price of internal generation—which includes GHG costs—is greater than the hurdle rate). The potential for this to occur is greatly reduced in comparison to the current "deeming" approach, which applies hurdle rates as low as zero, and does so for approximately 2/3 of all deliveries to California. Nevertheless, GHG program regulators may consider adjusting the unspecified rate to further limit this possibility, for example by establishing a higher rate during hours that higher-emitting resources may be the marginal producer of electricity in the external region.

Building upon the above example, it is informative to consider the outcomes that would occur if the lowest GHG-emitting resource that is capable of delivering to California (*i.e.,* hydro-based Generator A) decided to deliver its output as a specified-source import. Generator A has a strong incentive to do so, since, as a non-emitting resource, its resource-specific hurdle rate will be $0, and give it a competitive advantage over imports from other resources, which face the $13/MWh hurdle rate. The supply stack under this scenario is shown below:

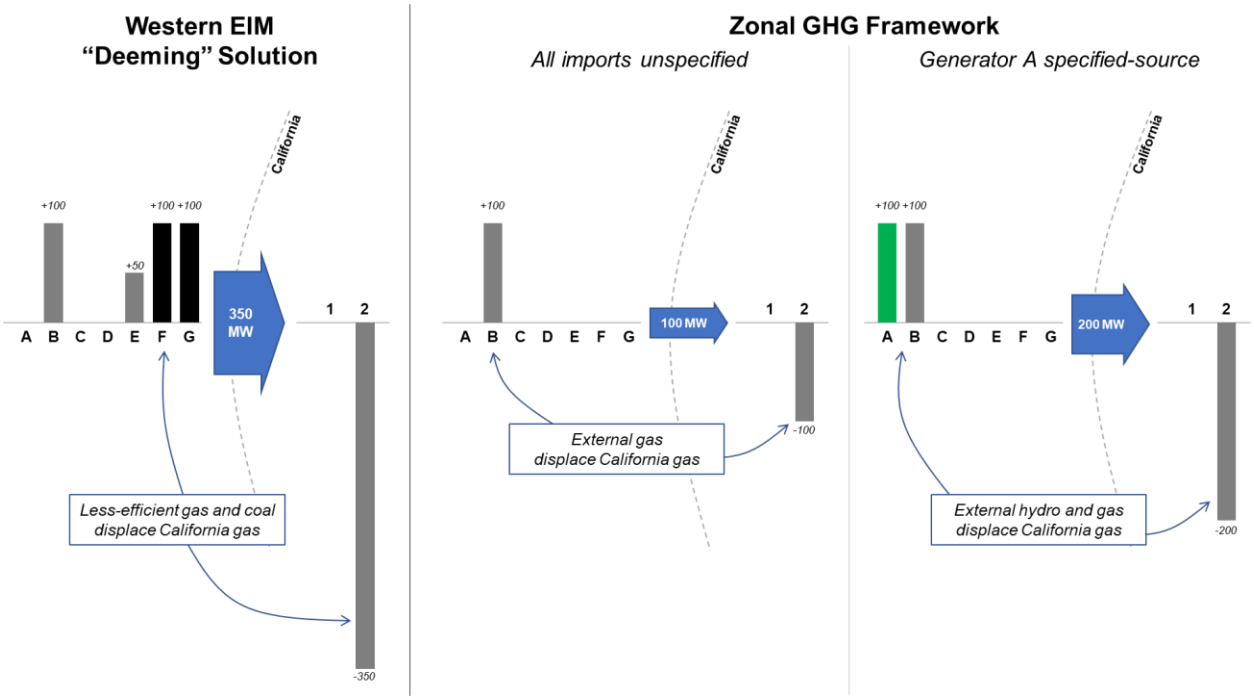
Illustration A-4: Supply Stack Based On Resource-Specific Fuel Cost, Resource-Specific GHG Cost, And Unspecified Rate For Imports



By meeting the requirements for specified-source deliveries, the hydro-based Generator A is appropriately recognized as the lowest total cost option for supplying imports to California, and is dispatched first. External Generator B is also dispatched for 100MW, as it is still economic to produce this electricity and import it under the unspecified hurdle rate of $13/MWh. Importantly, GHG revenues are now earned directly by Generator A, satisfying the key objective of compensating (and thereby encouraging) clean resources to increase output and arrange delivery to California. Consistent with the direct compensation of specified-source deliveries, external Generator A is also responsible for reporting and meeting the associated compliance obligations with the GHG program.

The figure below compares the dispatch solution under the Western EIM's deeming approach discussed earlier in the paper (left panel) to the dispatch outcomes achieved under the Zonal GHG Framework under the two scenarios discussed above (center and right panels).

Illustration A-5: Dispatch Solution Under Western EIM "Deeming" Approach And Proposed Zonal GHG Framework



Notably, the right-most scenario—in which hydro Generator A delivers as a specified source, and other supply is available to support unspecified deliveries to California—is identical to the optimal dispatch solution previously identified on page 13. In practice, considering the various different circumstances that can arise, the Zonal GHG Framework will not always achieve the perfect specified-source solution, but it can be expected to consistently achieve far better results than the current "deeming" approach employed in the Western EIM, while providing both incentives and mechanisms for further improvement.

The Zonal GHG Framework would also need to recognize and ensure compatibility with any additional requirements of GHG programs, including the need for imports to identify a First Jurisdictional Deliverer that is responsible for reporting and compliance with the GHG program's rules. The Zonal GHG Framework proposal includes provisions requiring each specified-source import to identify the First Jurisdictional Deliverer, and recognizes that it would need to determine an appropriate approach for unspecified-source deliveries in collaboration with the GHG program regulator.

The zonal approach would address each of the identified harmful consequences of the Western EIM's "deeming" approach, as shown below:

Table A-1: Comparison Of Western EIM "Deeming" Approach And Proposed Zonal GHG Framework

Criterion	"Deeming" Approach	Zonal GHG Framework
1. Provide accurate price signals, by increasing wholesale electricity market prices to reflect the cost of GHG emissions of producing electricity	**No.** Wholesale market prices are suppressed in the GHG-pricing program's jurisdiction (and for imports) as neither the resource-specific GHG emissions costs of the external resources that are dispatched and delivered to serve California load, or the unspecified rate is included in market prices.	**Yes.** Wholesale market prices will generally reflect accurate GHG emissions of imports, based on the GHG emissions from external resources that produce and deliver electricity to the GHG jurisdiction, and/or the applicable program's defined unspecified rate.
2. Require electricity producers to bear the cost of their GHG emissions when their electricity is imported into a GHG program's jurisdiction	**No.** GHG obligations are assigned to the "deemed" resource, not the resources that produce and deliver electricity.	**Yes.** All resources delivered to a GHG jurisdiction and earning the GHG price will incur compliance costs (directly or indirectly) based on their GHG emissions.
3. Provide additional compensation to entities that produce and deliver electricity from clean and low-emitting resources	**No.** GHG compensation is provided to entities willing to be "deemed", not to resources that produce and deliver clean supply.	**Yes.** Only clean and low-emitting resources that demonstrate increased production and delivery to a GHG jurisdiction will receive additional compensation
4. Where the specific resource producing electricity that is imported into a GHG program jurisdiction cannot accurately be identified, the import must be subject to a default GHG emission rate determined by the agency that administers the GHG program	**No.** Western EIM software applies hurdle rates that are frequently far below CARB's unspecified rate, and most often zero, and generally has no relation to the GHG costs of the resources that increase production.	**Yes.** Market software will have no ability to select a hurdle rate that is less than the established unspecified rate.
5. Avoid providing compensation to entities that do not demonstrably produce additional electricity that is delivered to the applicable GHG program's jurisdiction	**No.** Western EIM collects GHG revenue from California ratepayers and pays it on "deemed" quantities, which frequently exceed the actual increase in electricity production and may not even be deliverable to California.	**Yes.** Robust requirements for specified-source imports ensure GHG revenues are not paid to resources that do not produce and deliver electricity to a GHG jurisdiction.