Emissions Leakage and Resource Shuffling

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1. Leakage

The global nature of climate change creates challenges for California climate policy, which covers only a small subset of the sources contributing to the problem. This creates the potential for "leakage," a concept that is most easily illustrated by example. Consider an industrial producer operating in California that is required to purchase GHG allowances to cover its emissions. As a consequence, suppose this producer becomes relatively less competitive in the global market and thus loses market share to its out-of-state competitors. This induces a shift or "leakage" of production—and associated emissions—from the California firm to its out-of-state competitors.

For the purposes of this report, it is useful to distinguish between different forms of leakage:

- "**Emissions leakage**" refers to any change in emissions from sources not covered by the GHG policy or program that is *caused* by the GHG emissions policy or program. It is worth noting that leakage is a potential issue under *any* state climate change policy that increases operating costs of regulated entities, not just cap-and-trade. Leakage can also happen *within Califor*nia if there is excess capacity at in-state facilities that are exempt from the GHG regulations (e.g. industrial facilities that emit less than 25,000 tCO2 of GHGs per year are not covered by the GHG emissions trading program).

- "**Rent leakage**" refers to the transfer of profits from California entities to out-of-state producers that is induced by GHG regulations.

Minimizing emissions leakage caused by California's climate change policies is a statutory requirement of AB 32 and an important design objective of the cap-and-trade program. Economists have thought carefully about the various channels through which emissions leakage can occur. For the purposes of this report, it is useful to distinguish between two related but conceptually distinct leakage channels.[1]

- **Trade-competitiveness channel**: Policy-induced increases in operating costs can cause industrial production (and associated emissions) to move to jurisdictions outside the reach of the regulation via trade flows.

[1] The economics literature has also identified additional leakage channels via income effects and technology spillovers from induced innovation that can potentially induce "negative leakage" (see, for example, Gerlagh and Kuik 2014).

- **Fuel price channel**: If emissions regulations in a large open economy reduces demand for carbon-intensive inputs (e.g., fossil fuels), global input prices will fall and stimulate demand for these inputs in unregulated regions.

The conceptual distinction between these two channels is important for the assessment of leakage mitigation alternatives. Measures such as output-based permit allocations and border adjustments are designed to counteract the first channel. The second channel is much more difficult to mitigate or address.

Concerns about leakage loom large, so it is essential that California's cap-and-trade program incorporate a meaningful response to this problem. It is important to acknowledge ARB's pioneering work in this area. The output-based approach developed by ARB, which involves allocating production subsidies in the form of free permit allocation to those sectors deemed to be at leakage risk, has set a policy design example that other jurisdictions are studying and following. That said, the approach to determining the subsidy levels is increasingly set by political arrangement, rather than evidence-based analysis. In what follows, we acknowledge some of the formidable challenges that complicate leakage mitigation in practice, and point to critical knowledge gaps that could be usefully narrowed with additional data collection and analysis.

1.1 Assessing leakage risk

Correctly identifying the kinds of economic activities most at risk of carbon leakage is a critical first step in the design of effective risk mitigation (Fowlie and Reguant, 2018). Here, we will focus on emissions leakage as this, along with "transition assistance", rationalizes free permit allocations to emissions-intensive industries.

There is a growing body of research in economics that assesses the potential for leakage risk across a range of sectors and contexts. One methodological approach uses multi-sector and multi-region computable general equilibrium (CGE) models calibrated to represent global trade linkages and energy flows. CGE models can, in principle, capture multiple leakage channels. A limitation is that results can be very sensitive to assumptions about key parameters, such as trade elasticities.[2]

An alternative method, called partial equilibrium analysis, involves empirically estimating parameters that determine the extent of leakage potential via the trade/competitiveness channel (see, for example, Fowlie et al., 2016). Intuitively, emissions leakage in a particular industry via the trade/competitiveness channel can be defined as the change in out-of-state

[2] An "elasticity" refers to the change in a given parameter in response to the change in an input cost. For example, as used here, a trade elasticity refers to the change in the value of traded goods and services in response to an increase in energy prices attributable to California's GHG policies. Elasticities measure the proportional change in one term relative to another. For example, if the trade elasticity is –0.5, this means that for any given increase in energy costs, the value of traded goods and services decreases by half as much.

production that is induced by California GHG policies multiplied by the emissions intensity of that foreign production:

$$\text{Emissions leakage} = GHG_{out} \times \Delta Q_{out}$$

GHG_{out} (units: GHG emissions per unit of value of production) is the marginal emissions intensity of the out-of-state production that responds to a change in relative operating costs. As we explain in Fowlie and Reguant (2018), these marginal emissions intensity parameters are difficult to estimate empirically for several reasons:

- Reliable data measuring the carbon intensity of out-of-state production can be very difficult to obtain.

- Even if researchers can obtain a reasonable estimate of the average emissions intensity for a given industry and trading partner, this average could significantly over or under-estimate the marginal rate. Past work has documented tremendous variation in emissions intensities across producers in the same industry (Lyubich et al, 2018).

- Marginal emissions rates in a given sector/jurisdiction can change over time as out-of-state producers respond to changing terms of trade and factor prices. A marginal emissions intensity estimate constructed prior to the introduction of a policy need not apply once the policy takes effect.

A more concerted effort to gather data on the emissions intensity of industrial production in various jurisdictions outside would help inform leakage risk assessment efforts in California and beyond.

ΔQ_{out} (units: value of production) captures the responsiveness of out-of-state production to the introduction of GHG regulations in California. These industry-specific measures of supply responsiveness will in turn be determined by a number of factors, including the elasticity of the supply of imports to California, the elasticity of demand for exports from California, and the elasticity of production within California to policy-induced increases in operating costs. These elasticities are difficult to estimate empirically.

- One limiting factor pertains to data availability. For example, data on intra-national, interstate trade is very limited, making it next-to-impossible to assess how these trade flows might be impacted by changes in relative operating costs.

- A second complication concerns the identification of underlying elasticity parameters. It can be very difficult to disentangle the impacts of California climate change policies from the effects of other exogenous, time-varying factors.

These complications notwithstanding, careful work that seeks to evaluate how in-state production, imports, and exports are responding to policy-induced increases in operating costs can help inform our understanding of leakage potential across affected sectors.

1.2 Emissions leakage mitigation

California, along with other jurisdictions implementing GHG cap-and-trade programs, has been experimenting with using production subsidies to mitigate leakage in sectors deemed to be exposed to leakage risk. Under this approach, emitters are required to purchase cap-and-trade allowances to cover their emissions. But these same firms are freely allocated allowances based on output levels. Thus, the economic effect of this approach is that the producer sees both an emissions tax (via the market-based value for allowances, which provides an incentive to reduce emissions) and a production incentive (which helps to "level the carbon playing field" with respect to unregulated out-of-state producers).

This output-based free allowance allocation approach used in California can be used to strike a balance between incentivizing emissions abatement and mitigating leakage. However, it is important to stress that this strategy comes with side effects. First, an opportunity cost is incurred when allowances are freely allocated. If allowances were not freely allocated to industry to protect against leakage risks, they could be sold at auction and their revenue used to fund climate mitigation expenditures, cut taxes, or provide direct rebates to consumers. Second, output-based rebating dilutes the carbon price signal in those industries that receive implicit subsidies. This shifts more of the overall abatement cost burden onto producers who are subject to the cap-and-trade program, but ineligible for these subsidies. Thus, the use of output-based subsidies to mitigate leakage will generally increase the total abatement costs incurred within California to achieve a given level of abatement.

In sum, because output-based free allocation has potentially significant implications for both the costs of abatement and the distribution of who bears these costs, these interventions should be judiciously calibrated and targeted. To efficiently mitigate leakage, subsidy levels should ideally reflect the GHG emissions in external jurisdictions that are avoided when production activities remain within California.

Allocating valuable subsidies is an inherently political process, so there is a pragmatic need for a systematic approach that can be applied consistently and transparently across sectors. The current approach to calibrating output-based subsidies is ad hoc. In particular, there is no attempt to rationalize the recent increase in industry-specific allocation factors in terms of factors that determine emissions leakage risk (namely foreign emissions intensity and the responsiveness of out-of-state production to changes in relative operating costs). As we acknowledge above, estimating these parameters is a challenging and imprecise exercise. These complications notwithstanding, more could be done to ensure that production-based subsidies conferred to industry reflect true leakage risk.

As California's GHG policies increase in stringency and ambition, the efficiency and distributional implications of any mis-calibration of subsidies will become more significant. Additional data collection (e.g., on intra-national, inter-state trade flows) and analysis is needed to refine and improve the current approach to calibrating and conferring leakage mitigation compensation.

2. Resource shuffling

Resource shuffling is a specific type of leakage that can occur in energy markets. It is most commonly discussed in the context of electricity markets, but it can also occur in other energy markets, such as those for transportation fuels. The issue is most easily illustrated by example. Suppose a utility once imported power from a carbon-intensive coal plant prior to the cap-and-trade program's existence. In response to the new carbon price, the utility might decide to divest its contract with the coal plant and replace it with natural gas-fired electricity. While this swap will reduce the carbon intensity of the utility's imports, and therefore reduce its compliance obligations under the cap-and-trade program, it may not reduce net greenhouse gas emissions to the atmosphere if the divested coal-fired electricity is purchased by a utility outside of the cap-and-trade program.

Under California's cap-and-trade program, electricity importers are responsible for submitting compliance instruments to cover the greenhouse gas emissions associated with all imports.[3] As a result, electricity importers have a financial incentive to divest imports from high-carbon resources and replace them with low-carbon resources. Energy modeling studies have identified a significant potential for resource shuffling in the electricity sector (Chen et al., 2011; Bushnell and Chen, 2012; Bushnell et al., 2014; Borenstein et al., 2014).

Much of the progress California has made in reducing its greenhouse gas emissions in the electricity sector has been attributed to reductions in emissions from imports (ARB, 2018a: Figures 7-8). This underscores the importance of assessing the potential for electricity resource shuffling. In what follows, we identify four potential "channels" through which resource shuffling can manifest in the electricity sector. We then highlight some cross-cutting issues which we see as particularly pressing.

2.1 Bilateral Contract Shuffling

To the extent that California's climate change policies increase the cost of importing power generated by carbon intensive, out-of-state resources, electricity importers have an incentive to shift the type and duration of private bilateral import contracts towards less emissions intensive resources. If the electricity generated by the relatively more emissions intensive resources is shuffled to out-of-state consumers, California's GHG accounting will overstate the extent to which emissions have actually declined. This "contract shuffling" can occur via short-term bilateral trades, or it can manifest via the systematic divestment of California utilities' legacy ownership positions in, and long-term contracts with, out-of-state coal-fired facilities (Cullenward & Weiskopf, 2013).

Although ARB's regulations nominally prohibit resource shuffling,[4] ARB decided to exempt a range of so-called "safe harbor" practices—first via an informal guidance document in late 2012

[3] Cal. Code Regs., title 17, § 95852(b).

[4] *Id*. at § 95852(b)(2).

(Cullenward, 2014a) and subsequently via formal rulemaking completed in 2014.[5] Among the exempted "safe harbor" practices are any trades affecting legacy coal contracts subject to the provisions of SB 1018's Greenhouse Gas Emissions Performance Standard[6] and transactions in the day-ahead and real-time electricity markets operated by the California Independent System Operator (CAISO).[7] For a deeper discussion of how these safe harbors might operate in practice, see Cullenward & Weiskopf (2013: 21-26).

After ARB released its safe harbor exemptions to the prohibition on resource shuffling, California load-serving entities divested several major legacy coal contracts (Cullenward, 2014b). These divestitures reduced GHG emissions as reported in California's cap-and-trade program and GHG inventory. To the extent that electricity generated by affected coal plants was simply re-directed to out-of-state electricity customers, some resource shuffling and associated emissions leakage has already happened. To more rigorously estimate the extent to which resource shuffling has actually occurred, one would need to carefully construct a credible counterfactual scenario against which to measure the unit dispatch outcomes we actually observe.

2.2 Resource Shuffling via Retail Choice

As California embraces various new customer retail choice models in the electricity sector, another potential channel for resource shuffling is emerging. California electricity customers are beginning to transition from legacy retail service providers (e.g., an investor-owned utility) to become customers of new entrants (e.g., a community choice aggregator (or CCA)). According to one projection, by the mid-2020s, CCAs and direct access customers could be responsible for 85% of retail load in California investor owned utilities' service territories (CPUC, 2017: 3).

Many CCAs are contracting with existing out-of-state electricity resources, particularly in service of high-renewable energy retail choice programs. Historically, incumbent utilities have relied on relatively emissions-intensive out-of-state resources. If a CCA procures existing clean energy resources that were previously delivered to load-serving entities outside California, those external entities might replace them with higher-carbon alternatives. As demand for electricity supplied by incumbent utilities declines, the relatively emissions-intensive, out-of-state resources that once supplied California utilities in the past could be re-allocated to out-of-state customers in the future, leading to GHG emissions leakage.

There is some preliminary evidence that CCA procurement may be leading to resource shuffling (Rivard, 2018). Given the growing role played by CCAs, we see the potential for resources shuffling in the CCA context as a topic worthy of further investigation.

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5 *Id*. at § 95852(b)(2)(A).

6 *I*d. at §§ 95852(b)(2)(A)(2), (7).

7 *Id*. at §§ 95852(b)(2)(A)(2)(10).

2.3 Resource Shuffling in Regional Electricity Markets

Concerns have also been raised about resource shuffling in the context of the CAISO Energy Imbalance Market (EIM). The EIM is a real-time, bulk power market that dispatches electricity generating resources to meet short-term supply imbalances across much of the Western U.S. Out-of-state power plants are dispatched to CAISO if and only if they elect to become subject to the cap-and-trade program and submit a "GHG Bid Adder" that is based on facility-specific GHG emissions factors and the California cap-and-trade market price.

The GHG Bid Adder affects the EIM operator's dispatch order such that lower-carbon resources are preferentially dispatched to serve California load. Low- and zero-carbon resources outside of California thus have an incentive to opt in to the EIM to serve CAISO load. However, as relatively clean out-of-state resources are called on to supply California, higher-carbon resources may be reallocated to serve non-California EIM load. This is sometimes called "backfilling" or "secondary dispatch" (ARB, 2018b: 70-73; CAISO, 2018).

CAISO, ARB, and other stakeholders have been experimenting with ways to address this problem. Until recently, CAISO was testing what it called a "two-pass solution" where the EIM market algorithm would be run twice: once without the carbon price, and again with the carbon price included from entities' bids. By comparing these two real-time optimization results, CAISO hoped to identify resources that were being re-allocated across state borders in response to the carbon price.

However, some observers criticized the method's use for determining which resources should be deemed dispatched to California on the grounds that the two-pass solution could enable gaming of electricity market bidding strategies (Hogan, 2017). CAISO has since moved away from the two-pass approach. In principle, however, this approach could still be used to estimate the policy-induced increase in emissions from generating resources outside of California, even if CAISO adopts another method for determining which out-of-state resources are dispatched to serve CAISO load.

More recently, CAISO developed an alternative approach to mitigating leakage in the EIM that restricts the volume of power out-of-state generators can bid to serve CAISO load (CAISO, 2018) and filed for EIM tariff amendments with the Federal Energy Regulatory Commission in August 2018. FERC's regulatory review is ongoing as of this writing.

2.4 Renewable Energy Certificate (REC) and GHG accounting

Finally, there may be additional complexities associated with the accounting systems used to track power, GHG emissions, and RECs. One commenter (the Center for Resource Solutions) notes that ARB does not require electricity importers to retire the renewable energy certificates (RECs) associated with out-of-state renewables, yet nevertheless counts these electricity imports as zero-carbon resources for the purposes of the mandatory reporting regulation (MRR) and therefore for compliance obligations under the cap-and-trade program. As a result, the RECs associated with these renewable electricity imports are available for use outside of

California and could, if counted by external parties as zero-carbon resources, lead to double-counting of GHG emission savings.

We are unable to independently investigate these concerns due to the IEMAC's expedited schedule but believe that this issue merits analysis going forward. Additional work is needed to understand whether this approach leads to inconsistencies with state or regional mechanisms for tracking power, RECs, and GHG emissions, as well as whether additional data disclosures would allow other jurisdictions to harmonize their approaches and policy preferences with California's accounting decisions. We take no substantive position on these issues at this time.

3. Leakage-related matters in ARB's proposed regulations

Based on the very limited time in which the IEMAC was able to review ARB's proposed regulations, we have identified three key program design issues with potentially significant implications for leakage and/or resource shuffling.

3.1 Default unspecified emissions factor

One issue that merits close attention is the role of unspecified power in the cap-and-trade program, and GHG emissions accounting more generally. Under the regulations, electricity imports from specified power plants receive source-specific greenhouse gas emissions factors. But many California utilities import significant quantities of electricity from "unspecified" sources (Weissman, 2018). Under AB 1110, unspecified sources are defined as *"Electricity that is not traceable to specific generation sources by any auditable contract trail or equivalent."*[8]

In the MRR and cap-and-trade regulations, unspecified resources are assigned a default, time-invariant emissions factor of 0.428 tCO_2e per MWh.[9] This factor was developed in 2010 and was based on the average western grid supplies from the years 2006 through 2008 (Kaatz & Anders, 2016). Using this factor as the default, there is the potential for coal-fired generation to be classified as unspecified power for delivery to California at a substantially lower cost than it would face if made as a specified transfer.

Calibrating the unspecified emissions factor in a way that accurately reflect the emissions intensity of unspecified imports is challenging for two reasons.

First, the choice of default emissions factor changes the incentive market participants face when determining whether or not to reveal the source-specific emissions of their electricity imports. In other words, the composition of unspecified imports will depend in part on how the default emissions factor is calibrated. Electricity resources that are more GHG-intensive than the default factor (e.g., coal) may prefer transactional arrangements that are reported as unspecified imports, whereas those resources that are less GHG-intensive than the default factor (e.g., renewables) may prefer to find transactional arrangements that reveal them as

[8] Cal. Pub. Util. Code § 398.2(e).

[9] Cal. Code Regs., title 17, § 95852(b)(1)(C) (citing *id*. at § 95111(b)(1) (specifying the default unspecified emissions factor)).

specified sources, and therefore enable them to reduce costs. The default factor should be chosen with this supply-response in mind.

A second, related challenge stems from the significant heterogeneity in the emissions intensity of sources supplying the California electricity market. The average emissions intensity of generators that comprise unspecified imports could be very different from the average emissions intensity across all suppliers. It can thus be very challenging to identify the marginal resources that ramp up in response to increased demand for California imports.

We note that electricity import data from ARB and the California Energy Commission appear to be diverging, especially with respect to unspecified power (see ARB, 2018c; CEC, 2018). Additional analysis could be helpful to understand the causes of these differences and what, if anything, they mean for accuracy in tracking electricity emissions. There is nothing inherently problematic with different definitions of unspecified power that are used for different purposes. At the same time, however, differences in data reporting may enable analysts to evaluate whether market participant are responding strategically to default emissions factor and associated incentives.

3.2 Accounting for CAISO EIM emissions

As noted above, CARB initially supported CAISO's two-pass market optimization approach as a mechanism to provide a rigorous accounting framework for EIM emissions accounting. However, based on stakeholder feedback, CAISO determined not to implement the two-pass solution and instead has proposed a mechanism to FERC that limits the amount of energy an out-of-state power plant can bid to deliver to serve CAISO load (CAISO, 2018).

In the current cap-and-trade regulations, ARB has developed what it calls a "bridge solution" to address emissions leakage in the EIM market. Under this bridge solution, ARB must first estimate emissions leakage that has occurred. ARB does this by assuming that the true emissions associated with EIM imports is determined by the unspecified emissions factor, and therefore that the calculated leakage from EIM imports is the difference between the unspecified emissions factor and the source-specific emissions of resources that the CAISO EIM algorithm deems to be dispatched to serve CAISO load (ARB, 2018d: 15-16). Then, ARB will retire allowances to account for outstanding EIM obligations from the pool of allowances that remain unsold from the 2016-17 auction collapse. In the new proposal, ARB proposes to retire allowances from future program budget years to account for estimated emissions leakage associated with EIM transactions in 2018 and Q1 2019, rather than retiring allowances from the pool of temporarily unsold allowances from undersubscribed auctions (ARB, 2018b: 73).[10]

Beginning in Q2 2019, ARB proposes to calculate EIM-wide leakage using the method as for the "bridge solution" and assign this leakage in the form of annual compliance obligations for EIM

[10] Such a change may be necessary because the pool of unsold allowances from undersubscribed auctions is temporary and may not be available on an ongoing basis. See the Managing Allowance Supply subcommittee report for more details.

importers on a basis that is proportional to their share of total EIM electricity imports (ARB, 2018b: 72). From this point forward, there would be no need to retire allowances to account for leakage in the EIM because the calculated leakage would be assigned to EIM importers on an ongoing basis. Again, the leakage is calculated based on the difference between the source-specific emissions from power that CAISO deems delivered to California and the unspecified emissions rate, which is taken as the "true" emissions profile of EIM imports. Under the proposal, EIM importers would face compliance obligations that are equal to the emissions associated with source-specific imports that CAISO deems to be delivered to California plus a proportional leakage factor (ARB, 2018b: 72-73).

Based on a preliminary review, we believe that retiring allowances to account for emissions leakage from resource shuffling is a reasonable approach to preserving the environmental integrity of the cap-and-trade program, provided that this leakage can be credibly estimated. ARB's proposal to retire allowances first from the pool of unsold allowances, and later, directly from future budget years, is a sensible way to accomplish these ends.

However, there may be additional economic consequences to the proposed solutions that merit additional analysis. ARB's "bridge solution" would retire allowances that would otherwise be made available for sale to the entire market, reducing market-wide supplies and increasing the market-wide cost of program compliance to account for leakage. Under this approach—whether allowances are retired from the pool of temporarily unsold allowances from undersubscribed auctions, or future allowance budget years—the cost of mitigating leakage in the electricity sector is borne by all market participants.

In contrast, the proposal for Q2 2019 and beyond would impose the costs of mitigating leakage in the electricity sector on the electricity importers directly, rather than across all sectors in the cap-and-trade program. This could increase the costs of purchasing electricity imports via the EIM, which could in turn affect electricity importing decisions more broadly. It is possible that these effects would induce importers to switch away from EIM imports, where ARB calculates the "true" emissions at the unspecified emissions factor rate, and instead prefer bilateral contracts with the same low-carbon resources, which would be eligible for source-specific emissions accounting outside of the EIM and without mitigating leakage.

The subcommittee has not had sufficient time to review ARB's proposed methods in detail and therefore cannot express a final view on these important matters. However, it is clear that the concept behind ARB's new proposal will alter electricity market incentives. The market implications of these incentive changes will be important to study and monitor going forward.

Meanwhile, we note that under both the bridge solution and the proposed regulatory changes that would apply beginning in 2019, leakage in the EIM is calculated based on the assumption that the "true" EIM emissions are captured by ARB's unspecified emissions factor. Therefore, the effectiveness of this approach depends on the relevance and accuracy of ARB's unspecified emissions factor. As discussed in Section **Error! Reference source not found.**, the unspecified emissions factor has two important shortcomings. First, it is based on older data that may no longer be representative of actual average WECC-wide emissions. Second, it is a time-invariant

estimate of average emissions, not an estimate of the marginal emissions that result from the effect of California's climate policies on electricity imports at any given point in time. The subcommittee believes that further analysis of these issues is warranted.

3.3 Increase in Industry Assistance Factors in third compliance period

AB 32 and AB 398 require that ARB act to reduce GHG emissions while minimizing emissions leakage. To this end, free allowances are allocated to industrial emitters on the basis of their industrial output and leakage risk. As we note above, emissions-leakage-mitigating subsidy levels should ideally reflect the GHG emissions in external jurisdictions that are avoided when production activities remain within California.

ARB categorizes covered industrial sectors operating under specific NAICS codes as either high, medium, or low leakage risk. To calibrate the output-based subsidy, ARB uses the product of an industry-specific emissions benchmark and an "industry assistance factor" (IAF) to determine the number of allowances allocated to industries per unit of production. The IAF assigned to high, medium, and low risk industries has changed over time (see Table 1).

Table 1: Industry assistance factors in ARB regulations

Leakage risk	First Period (2013-2014)	Second Period (2015-2017)	Third Period (2018-2020)	Fourth Period (2021-2023)
2010 Regulation (Original rules) (ARB, 2011: Table 8-1)				
High	100%	100%	100%	N/A
Medium	100%	75%	50%	N/A
Low	100%	50%	30%	N/A
2013 Regulation (Current rules) (ARB, 2014: Table 8-1)				
High	100%	100%	100%	N/A
Medium	100%	100%	75%	N/A
Low	100%	100%	50%	N/A
2018 Regulation (Proposed rules) (ARB, 2018b: 59-64)				
High	100%	100%	100%	100%
Medium	100%	100%	100%	100%
Low	100%	100%	100%	100%
Legal authority:	ARB determines how to minimize leakage risks pursuant to AB 32			AB 398 requirement

As we note above, output-based permit allocation to targeted industries shifts abatement cost burdens to unsubsidized sectors and increases the costs incurred within California to meet California's GHG reduction goals. Given these side effects, production subsidies should be judiciously targeted. If the legal requirement is to mitigate varying degrees of emissions leakage risk, changes to the calibration of IAFs should be justified on the basis of analysis and empirical evidence on foreign emissions intensities and trade responsiveness within targeted sectors (see Section 1.1 of this report). In our judgment, the analysis offered in the proposed regulations does not explicitly provide such a justification. If instead the proposed change in free allocation is also intended to serve broader re-distributional purposes, a broader set of considerations may guide the targeting of production subsidies, including policy judgments that lie outside of this subcommittee's scope. In either case, the subcommittee believes that the benefits of conferring subsidies in the form of free allowance allocation should be weighed against the potentially significant costs.

4. Recommendations

We make several recommendations with regard to the monitoring and mitigation of emissions leakage in the context of its cap-and-trade program:

4.1 **Intra-national trade data.** In order to estimate emissions leakage potential for specific sectors in California, one needs data on intra-national, interstate trade transactions over time. Research to date has not fully leveraged the available data. Additional data sources could be used to construct a more complete picture of interstate trade in EITE industries. ARB could leverage the ongoing efforts of academic researchers to collect and analyze these data.

4.2 **Emissions intensity of out-of-state suppliers.** A critical determinant of emissions leakage is the marginal emissions intensity of out-of-state suppliers. Researchers are actively collecting data on the emissions intensity of industrial production in various jurisdictions outside California. A concerted effort to collect these data and assess their credibility would substantively inform leakage risk assessment efforts in California and other jurisdictions.

4.3 **Evidence-based decision making.** Rigorous empirical assessments of leakage risk are complicated by data limitations and identification challenges, as discussed in this subcommittee report. To date, these complications have limited the extent to which commissioned research informs California's approach to leakage mitigation. The subcommittee notes that the current abundance of caution has potentially important implications for abatement costs and the distribution of those costs. Methodological challenges notwithstanding, ARB should continue to work with the research community to strengthen the link between empirical evidence on leakage risk and the calibration of compensating subsidies.

4.4 **Resource shuffling.** The leakage subcommittee believes that the research and policy communities could benefit from further study of the extent to which emissions

leakage caused by resource shuffling may have occurred in response to the cap-and-trade program's carbon price signal, including with respect to divestment of legacy coal contracts and ownership interests pursuant to SB 1368.

4.5 **EIM leakage.** ARB should report its calculation of GHG emission obligations in the CAISO Energy Imbalance Market, including both the outstanding GHG emission obligations related to ARB's "bridge solution" for 2017, 2018, and Q1 2019, as well as for the new compliance obligations that will be imposed on EIM importers beginning in Q2 2019. ARB's analysis of these obligations should be transparent and publicly accessible. Furthermore, we recommend that ARB and other stakeholders monitor the effect of the proposed compliance obligations associated with mitigating leakage in the CAISO EIM. Not only does the estimate of leakage need to be accurate (see Recommendation 4.6 below), but the potential for the remedy to cause leakage to shift to sectors that lack leakage mitigation solutions should be carefully tracked. Additional analysis to compare the potential consequences of imposing leakage mitigation requirements on electricity importers versus the market as a whole would be helpful in understanding whether these risks are large or small.

4.6 **Unspecified emissions factor.** ARB should evaluate the unspecified emissions factor and consider updating it. The current factor is based on outdated data and may no longer be representative of unspecified imports in the current market environment. We specifically recommend that ARB consider how the choice of a default emissions factor may affect market behavior; higher default emissions factors are likely to encourage relatively low-carbon resources to self-identify as "specified" resources to avoid the higher default emission factor applied to unspecified resources, potentially improving the quality of data on California's electricity imports. Additionally, ARB should evaluate whether a default parameter that is calculated as an average is a reasonable proxy for the marginal emissions associated with electricity imports.

4.7 **Harmonizing electricity, RECs, and GHG data.** ARB works with the California Energy Commission and the California Public Utilities Commission to collect data on electricity imports, renewable energy certificates, and GHG emissions. Ensuring consistency between the data used across agencies is an important priority. Additional analysis to evaluate the different approaches California's regulators are using to track electricity imports and their environmental attributes would be helpful. In light of the potential for double-counting of GHG reductions associated with "unbundled" RECs that are used by out-of-state parties yet associated with electricity delivered to California, additional analysis could help evaluate (1) whether the risk of double-counting of GHG reductions is significant, (2) whether alternative accounting mechanisms would better address the multiple needs of REC and GHG reporting systems, and (3) whether additional data reporting could enable external jurisdictions and private actors mitigate the risk of double-counting for any particular accounting system in used in California.

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