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A Comparison of Three  
Cap and Trade Market Designs  
and Incentives for New Technologies  
to Reduce Greenhouse Gases

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## ABSTRACT

In 2008, California and other states are planning to adopt regulatory frameworks to govern their future emissions of greenhouse gases. This paper compares three potential cap and trade market designs:

- 1) source-based,
- 2) load-based, and
- 3) first-seller/deliverer,

as they would be applied to the electric power sector. To distinguish among these candidate designs, the paper considers how well each cap and trade design would meet several basic objectives of environmental markets, including the capability to provide the incentives needed for the development, deployment and utilization of new and innovative technologies. An array of improved technologies will be essential to achieve significant reductions in the emissions of global greenhouse gases. Hence, the paper also addresses the question: ***Which cap and trade market design will provide the best incentives to develop and utilize advanced technologies?***

First, the basic objectives of a cap and trade market are identified. Then, the capabilities to satisfy each objective are compared for the three potential cap and trade designs. These comparisons show that new technologies would realize higher values under source-based and first-seller/deliverer market designs than under a load-based system. The comparisons also show that a load-based regulatory system would be more complex, costly and inaccurate than either a source-based or a first-seller system. A further conclusion of this analysis is that the adoption of an integrated, source-based market design covering many sources in many states will provide the greatest opportunities for the innovation and advancement of new technologies, as well as for the success of a regulated cap and trade market for greenhouse gases.

*A source-based market design is preferable for its simplicity, lower costs, faster implementation, more accurate tracking and verification, and greater incentives for the adoption of lower-emitting technologies.*

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# 1. INTRODUCTION AND SUMMARY

In 2008, California and other states are planning to make path breaking decisions regarding the regulatory frameworks that are intended to govern their future emissions of greenhouse gases (GHG). To make these decisions, it is important to consider how well each potential framework will meet several basic objectives of environmental markets, including the capability of each market design to provide incentives for the development, adoption and utilization of new and innovative technologies. The three potential cap and trade market designs examined in this paper are:

- 1) source-based,
- 2) load-based, and
- 3) first-seller/deliverer,

as they would apply to the electric power sector.

In addition to evaluating how well each potential design will meet the basic objectives of an environmental market, this paper also addresses the question: ***Which cap and trade market design will provide the best incentives to develop and utilize advanced technologies?*** First, we identify the basic objectives of a cap and trade market for GHG. Then, we compare the capability of each of the three cap and trade designs to meet these objectives. A table on pages 5 and 6 briefly summarizes these comparisons, while the text following the table discusses each objective and market design at greater length. Finally, in the Conclusions section, we give our recommendations, which are also summarized at the end of this section.<sup>1</sup>

In a source-based market electric generators that burn fossil fuels will be the affected sources or, in other words, the point of regulation or, in other words, the point of compliance. An affected source must comply with GHG regulations by acquiring and surrendering emissions allowances (EAs) for each ton of emissions.<sup>2</sup> As the number of allowances issued declines over time, so will emissions. In a load-based regulatory approach the regulated entities that must comply are the Load Serving Entities (LSEs). LSEs are companies that generate or buy and then deliver electricity to their customers, i.e., the load. In a load-based regulatory scheme, each LSE must acquire and surrender sufficient EAs to cover the GHG content of all the electric power it delivers to end-users. In most cases, the LSEs are established electric utilities regulated by their respective state public utility commissions (PUCs). In a first-seller/deliverer market, the regulated first-seller/deliverer is the entity that first sells or delivers electric power into the state where that power is subsequently sold to end-users by an LSE. For example, if a fossil-fired electric generator is located within California and sells its power to Southern California Edison (SCE), the emissions source will be the first-seller. If, however, a generator is located outside of California, the first-seller of the power that is ultimately delivered to SCE might be either the generator/emissions source or an intermediary that has purchased power from that generator for resale, such as a power marketer or broker, or SCE itself, which may buy and import the power. Each of these three market designs would require compliance by a different set of entities, and each will impose different

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<sup>1</sup> The authors wish to thank Dallas Burtraw, Resources for the Future, Mike Katz and Kris Chase, VHC, for insightful comments on a draft of this paper. Of course, the views and opinions expressed here are those of the authors and do not necessarily state or reflect the views of anyone else. Any errors are the authors' own.

<sup>2</sup> In the electric utility sector the cap will most likely apply to carbon dioxide (CO<sub>2</sub>) emissions.



requirements on the measurement and verification of the GHG emissions content of the electric power consumed within California.

The basic principles of economics, as well as experience with cap and trade markets in the U.S., U.K. and Europe, tell us that these three market designs are likely to have significantly different effects on the development and deployment of new and cleaner technologies.<sup>3</sup> In general, investments in improved and innovative technologies will be most likely to occur if the costs of GHG are clearly valued and internalized in the prices of the outputs or services provided by these technologies. Technologies suitable for global deployment will have greater opportunities for funding, demonstration and ultimate success than technologies developed to meet only localized market needs. Hence, regional market design should encourage access to global markets by allowing verified “offset” projects that utilize new technologies and will move them more rapidly along their developmental learning curves.<sup>4</sup>

Competitive markets should have many buyers and many sellers.<sup>5</sup> It is evident that source-based and first-seller/deliverer markets would involve more buyers and sellers than a load-based market, where the number of regulated electric Load Serving Entities (LSEs) is smaller than the number of GHG sources and first-sellers that would be regulated under the other two alternatives. The smaller number of regulated LSEs in a load-based market could lessen the volume and frequency of emission allowance (EA) trades, as well as the degree of competition, giving rise to market power concerns. Moreover, in a load-based market the need to use imputed GHG emissions to characterize many electric power transactions that originate out-of-state will mask market signals and give rise to gaming opportunities for higher emitting generators. Imputed emission rates will cause lower-emitting electric generators to prefer bilateral contracts with LSEs, in order to realize the value of their lower GHG emissions.<sup>6</sup> Overall, the use of imputed emission rates will lessen the environmental integrity of all allowances in a load-based market.<sup>7</sup> As will be described below, these

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<sup>3</sup> See, for example, the presentation by a former U.K. regulator who helped make the transition between the U.K.’s load-based GHG market and the European Union’s Emissions Trading Scheme: [Olivia Hartridge, Greenhouse Gas Cap and Trade Systems: Symposium on Linking](#). Presentation to the California Public Utilities Commission, April 19, 2007.

<sup>4</sup> Offsets are real, measurable, verifiable, additional and enforceable GHG reductions at entities that are not required to make reductions by a regulatory system. Some have argued that by limiting the reductions that can be counted as verified “offsets,” local technological innovation will be encouraged. This is not the most likely way to encourage innovation, because the need for global GHG reductions will create far larger opportunities to sell a wider variety of improved technologies than local or regional markets can provide. In most cases, first movers into offset markets, whether domestic or foreign, can gain a competitive advantage and progress more rapidly along the technological learning curve at lower costs and with greater profit opportunities than can be achieved in localized markets by themselves.

<sup>5</sup> The number of buyers and sellers can be increased by allowing “offsets” and enabling allowance trading between regional markets, such as the European Union’s Emissions Trading Scheme and the U.S. Regional Greenhouse Gas Initiative states. Interregional emissions trading can keep regional costs down, while enabling the development of new and improved technologies.

<sup>6</sup> Imputed emission rates are administratively determined rates, rather than actual measured rates. They are expected to be calculated average rates assigned in advance to transactions between a generating region, e.g. the Southwest, and a buying region, e.g. California.

<sup>7</sup> The masking of GHG costs in a load-based market and the perverse incentives given to emitters are referred to as *adverse selection*, which is an undesirable characteristic for any market. This characteristic arises partly from the use of imputed emission rates for imported power, and it would significantly reduce the environmental integrity of load-based emissions allowances for GHG.



characteristics and other features of the three market designs will also lead to different effects on technology investment, operating and purchasing decisions.

The strengths and shortcomings of source-based markets have been tested in practice, while there are many shortcomings of the load-based approach that will make this market design more costly and not scalable up to multi-state or regional coverage levels. The first-seller/deliverer approach is a hybrid of these two market designs and is expected to have impacts falling in between the effects expected for the other two approaches.

In summary, the comparisons presented below show that a load-based system would be more complex, costly and inaccurate than either a source-based or a first-seller market design.<sup>8</sup> As a result, clearer market signals to buyers and sellers and increased incentives for technological innovation are more likely under the source-based and first-seller/deliverer market designs. Therefore, to comply with California's Assembly Bill No. 32 (AB 32) passed in 2006, we recommend that California and other western states adopt an integrated, source-based cap and trade system with broad enough geographic coverage to include most of the power sources now serving California and other western LSEs. As a second choice, which would incur unnecessary costs prior to the transition to a national cap and trade system, we recommend that California and other western states adopt a first-seller/deliverer market design with provisions for replacing it with a national source-based system, as soon as possible.

## 2. OBJECTIVES FOR GHG CAP AND TRADE MARKET DESIGN

The primary goal of a GHG cap and trade market is to:

- Reduce regional GHG emissions to levels set by emission tonnage caps in an efficient and cost-effective manner.

GHG reductions will occur, if a market design properly internalizes the costs of GHG emissions in the prices of goods and services, and if there are appropriate penalties for non-compliance. In order to internalize the costs of complying with emissions regulations, entities must pass along their compliance costs, so that all market participants receive proper price signals. Then emitters, intermediaries and consumers can select the most economically efficient products, including environmental costs. In turn, cap and trade provides emitters with an effective market mechanism to reduce their own GHG compliance costs by trading EAs when it is economic to do so.

Emissions will be reduced as the number of allowances declines over time. Since different parties will be able to control or avoid emissions at different costs, there will be opportunities for allowance trading. The success of the market depends on having many buyers and many sellers, such that a competitive supply/demand balance creates a market clearing price signal. For those sectors with similar costs of control or where the burdens of regulation might be prohibitive, a pre-combustion or upstream point of regulation may be preferable, such as imposing an emissions tax on gasoline. In successful cap and trade markets to date, the emitter bears the burden of compliance. By reducing emissions to meet a cap regulated by EAs, products can become more cost-competitive and environmentally friendly.

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<sup>8</sup> Trying to institute a regional load-based cap and trade system and failing to achieve fundamental market objectives would set back public confidence in any carbon emissions reduction scheme.



A cap and trade market will internalize the costs of GHG and operate efficiently, if it satisfies the following objectives:

- Initiates *clear market price signals* for GHG allowances that are internalized in product prices,
- Creates *uniform and stable GHG allowance prices* across market sectors and diverse sources with different compliance costs,
- Maintains the *verified environmental integrity* of allowances, so that trading can occur among many market participants across geographic and political boundaries,<sup>9</sup>
- Keeps *monitoring, administration and transaction costs low*,<sup>10</sup>
- Minimizes the *overall costs* of compliance,
- Promotes *research, development and demonstration (RD&D) of lower emitting technologies*,<sup>11</sup>
- Provides incentives to *purchase and use lower emitting technologies*,
- Enhances *environmental justice*,
- Keeps the *basic rules and functions simple and enforceable*,
- Avoids *unintended consequences*,
- Enables the *timely transition to a geographically larger regional or national system* for emissions reduction and is *scalable in size*,<sup>12</sup> and in California,
- *Satisfies* requirements under Assembly Bill No. 32 (AB 32).

### 3. COMPARISON OF THREE CAP AND TRADE MARKET DESIGNS FOR EACH ENVIRONMENTAL MARKET OBJECTIVE

The table below summarizes the capability of each market design to achieve the objectives listed above, while the sections that follow discuss each objective in more detail.

<sup>9</sup> To achieve and maintain “environmental integrity” GHG allowances must be tied to accurately measured, verifiable and enforceable tons of GHG emissions. The environmental integrity, equity, efficiency and timing of allowance allocations, trading procedures and compliance rules, such as banking or borrowing, are key design elements that will determine how well this future market functions.

<sup>10</sup> There are no essentially no mandated transaction costs for GHG emissions in those locations where it is not currently regulated or where there is not voluntary compliance. Mandated transaction costs that are too high will inhibit the utilization of a cap and trade system.

<sup>11</sup> Meaningful global GHG reductions will not be achievable without developing new, lower-emitting technologies and making behavioral changes in the ways in which we use existing technologies. Because of the scale of energy sector technologies that will be needed and market failures that inhibit RD&D, other incentives will be needed in addition to a market design that is favorable for recovering costs and operating at a profit. Regulatory uncertainty can significantly inhibit investment in both existing and developing technologies, regardless of future market designs.

<sup>12</sup> While state-by-state regulations are an important start, achieving the ultimate goal of global GHG reductions requires a U.S. national regulatory system that can reduce emissions at least cost. However, at the same time as a cap and trade market creates the demand for improved technologies to reduce GHG, additional incentives will be needed to create them because of the uncertainty of future GHG allowance prices and R&D market failures.



## Comparison of Greenhouse Gas Market Designs – Source-based, Load-based and First-Seller/Deliverer

| Objective:<br>Market Design:  | Initiates clear market price signals for greenhouse gases (GHG)  | Creates a uniform and stable GHG allowance price  | Maintains the verified environmental integrity of emissions allowances (EAs)  | Promotes research, development and demonstration (RD&D)   | Provides incentives to purchase and use lower emitting technologies  | Keeps monitoring, administration, and transaction costs low   |
|-------------------------------|--|---|---|---|--|---|
| <b>Source-based</b>           | Changes supply curve: GHG EA costs internalized in kWh prices, allowing pass through of costs to all buyers, such as Load Serving Entities (LSEs). Markets can be linked globally. | Buyers will see internalized GHG price signals from those emitters covered by a cap. A uniform market clearing price will be created for EAs, and inter-regional trades will occur. | Source-based monitoring, tracking system and verification protocols provide ongoing integrity for EAs and certified emission reductions (CERs) at individual sources. | Sources must acquire sufficient GHG allowances to cover emissions and over time must find ways to reduce GHG. Regulated sources may fund some R&D, but will primarily own/buy new technologies. | Reducing costs of compliance with declining EA allocations over time provides incentives to develop, buy and operate improved lower-emitting technologies. | Systems and procedures are proven & tested. These costs should be reasonably low for sources that are already regulated for other emissions.            |
| <b>Load-based</b>             | Changes demand curve only from regulated buyers. Price signals to ratepayers and EA price signals from LSEs to power providers will be different.                                  | Cap applies only to regulated LSEs – not to sources. Unregulated emitters might evade the cap by selling to unregulated LSEs elsewhere in the western region.                       | Imputed GHG from out-of-state (OOS) & system sources will lack environmental integrity. All EAs could be price discounted or not tradable OOS.                        | LSEs are not usually the direct buyers of improved GHG emitting technologies. Less incentive to fund R&D, since EA costs passed thru to ratepayers.   | Unless they own emission sources, regulated LSEs are not likely purchasers of low emitting, supply-side technologies, but will buy from cleaner sources.   | Very high administrative and tracking costs unless emissions from out-of-state are imputed. Cross-checks needed. Not fully MRTU compatible.             |
| <b>First-Seller/Deliverer</b> | First-deliverer sends market price signal to LSEs and to emitters. First-deliverer may be an emitter or a market intermediary.   | In-state sources & first-deliverers would create a uniform EA price, but must compete with OOS power sources selling to buyers outside of capped region.                            | Hybrid compliance market. In-state EAs verifiable; out-of-state not tracked as accurately, resulting in discounted prices for all CA allowances.                      | If first-deliverer is an emitter, then EAs give some incentive to fund R&D and to buy innovative & new technologies. If it is a marketer/reseller, probably not.                                | If first-deliverer is an emitter, then declining EAs will provide some incentive. LSEs & others will prefer to buy power from cleaner plants.              | High costs, since brokers will have difficulty forecasting their EA needs and tracking & allocating the GHG content of their power imports and resales. |





## Comparison of Greenhouse Gas Market Designs – Source-based, Load-based and First-Seller/Deliverer (Continued)

| Objective:<br><br>Market Design: | Minimizes overall costs of compliance   | Enhances Environmental Justice (EJ)  | Keeps basic rules & functions simple and enforceable   | Avoids unintended consequences   | Enables timely transition to a regional or national cap and trade system & is scalable in size   | Satisfies requirements under California Assembly Bill: AB 32   |
|----------------------------------|---|--|--|--|--|--|
| <b>Source-based</b>              | Provides greatest source diversity and EA trading opportunities to reduce overall compliance costs. Most easily linked to & consistent with RGGI* and EU ETS* designs.    | Provides some incentive to develop new technologies & to replace existing higher emitting urban plants. Thus, should be EJ preference, but is not now.                         | Scalable up in size. Source specific rules and incentives to comply are the simplest. GHG emitted is easier to measure, track, verify and enforce.                               | Will internalize GHG costs most efficiently, leading to fewer market surprises and fewer “gaming” opportunities and better compliance with declining emissions caps.     | Used for today’s successful SO <sub>2</sub> , NOx & EU ETS GHG cap and trade programs. Will likely be the U.S. national system. Transition would be easiest. Global trading also viable. | Yes, but only if most states in Western Electric Coordinating Council (WECC) selling power to CA adopt source-based reporting standards and a GHG cap.                 |
| <b>Load-based</b>                | Highest in costs due to fewer LSEs, fewer verified EAs and fewer trades plus high admin costs. Some market power concerns. Not easily linked to RGGI or EU ETS or nation. | Could lead to earlier replacement of urban plants than costly command & control regulation. But existing plants will remain longer than under source-based cap & trade design. | Not scalable up in size to WECC or nation, due to exponential growth in # of transactions as more LSEs are included. Imputed GHG not verifiable – <i>a ton may not be a ton.</i> | Will encourage “contract shuffling” and “contract squabbling” and discourage power imports to CA utilities, possibly causing higher CA and WECC prices, as in 2000-2001. | Not scalable up in size to cover a multi-state region. Not easily transferable to a source-based system. Wasted time, effort and money, when a national system is adopted.               | Yes, but only on an imputed index basis, due to need to impute GHG emissions from imported power to each state, which can not be tracked accurately or cross-verified. |
| <b>First-Seller/Deliverer</b>    | Will be higher in cost than a source-based system, but lower in cost than a load-based design.  | All three cap and trade market designs are more likely to replace urban plants than more costly command & control GHG regs.  | Similar in many respects to a source-based design but with difficulties for out-of-state first-deliverers selling imported power.  | Marketers and out-of-state power plants may choose to sell to buyers in unregulated states, causing higher CA prices.  | First-deliverer compliance systems and procedures will be more easily transferable than would a load-based system.   | Yes, on an index basis, but only if all first-sellers/deliverers can accurately verify & allocate GHG emissions to each transaction.                                   |

\*RGGI = Regional Greenhouse Gas Initiative, states in the U.S. northeast starting a source-based GHG market in 2009. EU ETS = European Union Emissions Trading Scheme



## Clear Market Price Signals

A multitude of decisions must be made by investors to create and commercialize new technologies and by consumers to adopt and bring them into widespread use. In the best case, emission regulations should encourage the adoption of better technologies, and, at worst, should not impede their adoption by masking the value of lower emitting technologies.

In any competitive market, price signals are the basic driving forces that influence investment and operating decisions. In a cap and trade market "...consistent and stable price signals will determine whether investors make long-term investments. Proper implementation and execution of a cap-and-trade system will send such price signals. Additionally, EAs need to be scarce enough to limit supply and warrant a price that is significant enough to encourage investments. Minimizing the price volatility of EAs will also encourage long-term investments."<sup>13, 14</sup>

### Source-based market design

In this established market design, regulated emission sources are the entities that must comply with emission caps and, thus, affect market price signals by either buying or selling or banking allowances. GHG sources must comply by acquiring and surrendering the number of allowances needed to cover their emissions during a designated compliance period, e.g., over one year. Each source faces marginal compliance costs that equal its own marginal costs of reducing a ton of GHG or the price of purchasing a GHG EA in the allowance market, whichever is less.<sup>15</sup>

The source-based design is the most straightforward and provides the clearest, most transparent and direct market signals.<sup>16</sup> In a source-based system allowance costs originate at the emissions source, i.e., the electric generator, and will be passed along to wholesale buyers of electricity, such as LSEs. In turn, allowance costs embedded in the price of purchased power will be paid for by the LSE's customers in their retail electric bills. Thus, a source-based market signal for allowance prices will be internalized in the price of

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<sup>13</sup> Southern California Edison Company, Response Of Southern California Edison Company (U 338-E) To Administrative Law Judge's Comments And Legal Briefs On Market Advisory Committee Report. CPUC Rulemaking 06-04-009. August 6, 2007. p.16.

<sup>14</sup> Cap and trade markets have exhibited price uncertainty and volatility. Both are dependent on the perceived supply/demand balance over time and the liquidity of vintaged EAs. In the future, maintaining stable EA prices will require certainty about the caps, as well as the implementation of new technologies to reduce emissions and, hence, to reduce the demand for EAs as the supply of EAs declines over time.

<sup>15</sup> Even if allowances are awarded at no cost to regulated sources, the value or opportunity cost of an allowance of a particular vintage equals the market price of that vintage allowance at any given time.

<sup>16</sup> If the cost of producing and delivering electricity from an individual generator is sufficiently below the delivered, market-clearing wholesale price for electricity to enable all the generator's GHG compliance costs, including allowances, to be included in a generator's sales price, GHG costs can be internalized and will be paid for by the LSE when it purchases wholesale power from the generator.



electricity and will be reflected in the purchase decisions of buyers. As discussed in the next section this is not the case in a load-based market.<sup>17</sup>

A source-based framework is the market design applied in successful emissions markets to date, such as the U.S. markets for sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) and the European Union Emissions Trading Scheme (EU ETS) for GHG. A source-based cap and trade market works best for large geographic areas encompassing many sources. For example, the Western Electricity Coordinating Council (WECC) would be an appropriate region for implementing a viable electric sector GHG market in the western U.S. When the environmental integrity of emissions from individual sources can be tracked and verified, it is likely that trading will also be allowed between sources and other market participants located in different regional allowance markets at prices determined by the market participants conducting allowance trades.

### Load-based market design

This market design was proposed, because the electricity purchases of investor-owned electric utilities (IOUs), which are the predominant Load-Serving Entities (LSEs), are regulated by state public utility commissions (PUCs). If it is authorized to do so by state law, a state PUC can create an allowance system, issue a limited number of allowances and require its regulated LSEs to surrender allowances associated with the GHG content of their power purchases and generation. In this market design LSEs, not emissions sources, are the originators of price signals.<sup>18</sup> Since power generators do not need to acquire any allowances, generators will not embed allowance prices in their power sales prices. However, the combined market prices of power and allowances to the LSE will influence the upstream busbar prices at which generators will be willing and able to sell power. To the extent that GHG allowance costs are also passed through in an LSE's retail electricity rates, a different downstream price signal determined by each PUC's regulatory rate design will reach electricity consumers.

Power plants in the WECC can sell to many potential LSEs, and market brokers and intermediaries can buy from many power plants and sell to multiple LSEs, often simultaneously. Hence, the GHG price signal sent from individual regulated LSEs to electric generators that are not under contract may be partially or fully *avoided* by those generators selling to unregulated LSEs and to market brokers. Unlike a source-based

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<sup>17</sup> To the extent that the delivered, market clearing price of electricity allows each generator to recover its GHG allowance costs, wholesale prices will internalize the costs of GHG. This is straightforward for a source-based market, since generators are the point of compliance and will bear the costs of compliance. In a load-based market, the point of compliance is the LSE, so the costs of allowances will not be embedded in the wholesale price of electricity.

<sup>18</sup> Determining the GHG allowance price signal for each LSE's portfolio of power purchases at any given time will not be an easy task in a load-based market, which will have the potential to encourage gaming and to conflict with dispatching practices under the California Independent System Operator's Market Redesign and Technology Upgrade, and under potential rules for assigning imputed (i.e., specified administratively, not measured) emission rates. Each LSE is likely to have a different effective avoided GHG price signal, which can vary hourly or more frequently. As a result, LSE's are likely to adopt a time-averaged effective GHG price for making purchase decisions and scheduling their own generation resources.



market where the allowance price will provide an incentive for all affected GHG emitting generators to reduce their emissions, the LSE's market signal in a load-based market will not provide inframarginal generators with an incentive to reduce their GHG emissions.<sup>19</sup> In addition, today's price responsive practices in power markets, including exchanges and purchases of ancillary services, may have to be artificially modified, in order to reflect the load-based price of allowances.

In California, the dispatch of power plants will be based on new rules expected to go into effect in 2008. The Market Redesign and Technology Upgrade (MRTU) rules approved by FERC require that the California Independent System Operator (CA ISO) dispatches power plants needed for system reliability and load following based on the prices bid by each generator. In a load-based system these bid prices will not include the costs of GHG allowances, so under MRTU the CA ISO will dispatch the least-cost generators without direct regard to GHG allowance prices. LSEs will need to estimate the GHG amounts from ISO dispatched units, in order to develop their resource scheduling and contracting strategies intended to enable them to meet their caps. In a load-based market an LSE's GHG goals may conflict with MRTU requirements, and EA prices will not influence plant operations as they would in a source-based market.

As in the other market designs, the downstream GHG price signal to consumers will be controlled by public utility commissions that devise different rate schedules for specific customer classes. Because the costs of allowances will not be included in the wholesale price of power purchases by LSEs, as they would be in a source-based system, generator dispatch and operating decisions will not fully reflect the costs of allowances. Moreover, according to some proponents of the load-based design, PUCs ought to shield ratepayers from the marginal costs of GHG control.<sup>20</sup> In any event, downstream GHG market signals to consumers from LSEs will be set by regulators, not by market forces. Hence, the GHG price signals actually experienced by retail consumers could be significantly different from the adulterated GHG price signals sent upstream by each LSE to its suppliers.

#### First-seller/deliverer market design

The first-seller/deliverer approach is a hybrid approach, depending on whether an emissions source is located inside or outside of California. The EA price signal for sources within California will be source-based. For sources outside California, the compliance responsibility lies with the first-deliverer of the power to a California location or entity. If the first-deliverer has only one supply source for a contracted supply delivered to a California entity, then a direct price signal will be transmitted upstream to that electric

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<sup>19</sup> This and other characteristics of a load-based market design are also discussed in "Burtraw, Dallas. State Efforts to Cap the Commons: Regulating Sources or Consumers? Resources for the Future. Presented at the Conference of the Association for Public Policy and Management, November 9, 2007. This paper concludes that "the load-based approach is not consistent with market reform and greater competition in the electricity sector." It also warns that "a poorly designed market can lead to poor incentives and poor accountability that can bridge to other sectors and undermine confidence in climate policy." p.12 and p.17.

<sup>20</sup> Richard Cowart, presentation to the California Public Utilities Commission (CPUC) Workshop, August 21, 2007.



generator/GHG emitter. However, if the first-deliverer has multiple supply sources at any given time, then the strength and magnitude of the market signal moving upstream will depend on an allocation by the first-deliverer and the timeliness of that market signal. Overall, as the size of a regulated first-seller/deliverer market increases, so that most potential sources are included, allowance prices and electricity market signals should be similar to a source-based system, but with the difficulties of tracking and compliance placed on the first-seller/deliverer. These difficulties will grow in complexity as more generators sell into a first-seller's supply portfolio.

Try to imagine the complexity of keeping track of CO<sub>2</sub> emissions monitored for every hour at each electric generator being followed through the grid and allocated to each LSE taking power from that source during each hour throughout the entire Western grid. The scale of such data gathering and tracking can be compared to the complexity of each source filling out a quarterly report from data collected by its own Continuous Emissions Monitoring System (CEMS) to account for its own hourly emissions. This type of reporting is currently performed by power plants, so that piggybacking CO<sub>2</sub> on top of the NO<sub>x</sub>, SO<sub>2</sub> and other pollutant reporting already taking place should be relatively easy. Cross-checking and verifying total emissions within a region will also be far easier under a source-based system. Furthermore, the first-seller and the load-based approaches both encourage a mapping or "contract shuffling" of cleaner resources that would be sold to California LSEs at a premium without necessarily changing the dispatch of any resources that are located out-of-state.

In addition, because the first-seller's price signal, as well as a source-based price signal, will internalize the costs of GHG allowances in the wholesale price of power sold to an LSE, current electricity market bidding, operating and dispatch practices can continue, maintaining the market responsive practices that occur today in the operation of the electricity grid.

### **Uniform and Stable GHG Allowance Prices**

Three attractive features of allowance trading are the ability of trades to cross geographic and political boundaries, the ability of caps to set the level of allowable emissions and the ability of regulated entities to achieve lower compliance costs than if emissions taxes or command and control regulations were imposed to achieve the same level of reduction.<sup>21</sup> Provided that GHG allowances are accorded equivalent environmental integrity, the allowance commodity can be traded across geographic and political boundaries at equal or nearly equivalent prices. Even if each GHG allowance market differs in some of its rules, brokers and market intermediaries can establish relative prices for trades, provided that each ton is verified and there is comparability in the relative supply/demand balance of allowances issued in each jurisdiction. GHG markets with broad coverage will have a greater number of market participants and will enable more diverse technologies to participate. In a market that achieves stable allowance prices, it is likely that the incentives

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<sup>21</sup> The ability for allowance trades to cross political borders to capture a greater diversity of compliance costs is cited as one reason to prefer a cap and trade approach to applying emission taxes that are politically localized and are also likely to be more expensive in achieving a given level of GHG emissions.



to innovate and develop new technologies will be greater than in a market with volatile and uncertain allowance prices.

### Source-based market design

Successful allowance trading markets to date have been source-based. In these markets a *uniform market clearing price* exists and is used as the basis for allowance transactions within the market. The internal allowance price is also a benchmark for the transfer of offset allowances into the market, such as Certified Emission Reductions (CERs) into the EU ETS market. In the case of forward allowance transactions for “offsets” to be provided by future reductions at projects with lower perceived environmental integrity, the allowances to be created by these projects will be traded at a discount to offsets provided by verified reductions with higher environmental integrity.<sup>22</sup> A stable, uniform allowance price for allowances of the same vintage will facilitate trading, increase the volume of allowance trades across market boundaries, and, thus, encourage the implementation of improved technologies to reduce GHG emissions.<sup>23</sup>

### Load-based market design

A uniform market price for GHG allowances can be established within a load-based market, but trading among the relatively few LSEs may be limited, creating a thin market with the potential for manipulation and exercise of market power. Moreover, the inaccuracies introduced by imputing emissions is likely to dilute the value of California’s GHG allowances, since continuous emission monitors and established authentication methods cannot verify the environmental integrity of some fraction of the out-of-state emissions.<sup>24</sup> Compliance with a load-based cap can be achieved by surrendering one allowance for each ton of imputed or measured emissions. However, if a coal-fired power plant’s emissions can be counted at the lower imputed emissions rate, the parties to such a transaction will be getting an effective discount on the number of allowances required, thus, lowering the effective price paid for each ton of such GHG emissions without being reflected in the allowance market.

Imputed emission factors for imports could be different between different states at different times, leading to pricing anomalies for a ton of emissions reduction or to gaming opportunities for sources emitting at a higher rate than the imputed rate.<sup>25</sup> In this

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<sup>22</sup> For example, in November 2007, vintage 2008 Certified Emission Reduction (CER) credits from Clean Development Mechanism (CDM) projects trade at a 23% discount to vintage 2008 European Union Emissions Trading Scheme (EU ETS) allowances.

<sup>23</sup> A source-based market is more likely to behave like a competitive market than a load-based market, where regulators oversee the decisions of LSEs.

<sup>24</sup> Roughly one-half of California’s GHG emissions associated with electric LSEs come from out-of-state sources. A number of these transactions come from identifiable generating units; however, many transactions do not.

<sup>25</sup> Out-of-state power sources emitting GHG at rates lower than the imputed rate would prefer to enter into bilateral agreements that would pay a premium for their lower emissions rates in a load-based system. In contrast, power sources with higher emission rates would prefer to be treated as system resources that would be given the lower imputed rate. Such perverse incentives constitute “adverse selection.”



situation, a power plant that reduces its GHG emissions by one ton could extract a different value for that ton, depending on the mix of generators in the state where its power is consumed. Although each allowance can be surrendered to cover one ton of emissions, without accurate verification of the emissions, all allowances in a market with verification problems will be less acceptable for trading into other regional allowance markets and would trade at a relative discount.

#### First-seller/deliverer market design

The rules for awarding and authenticating allowances have not yet been determined. However, the perverse incentives associated with the use of imputed emissions would not exist in either source-based or first-seller systems, because the price of power sold to LSEs in each system will include the value of allowances.

### **Verified Environmental Integrity**

The success of any emissions trading program depends on the level of confidence and trust between buyers and sellers. The maintenance of *environmental integrity* requires that “Any emissions covered by the cap-and-trade program must be monitored, reported, and verified to a high degree of accuracy. The inclusion of sources with emissions that are difficult to measure or verify would create the potential for undetected non-compliance and thereby undermine the environmental integrity of the system. If necessary data are not available, then the breadth of the program should be limited so that sources for which reliable emissions information is lacking are not included in the program.”<sup>26</sup>

#### Source-based market design

Since the emissions sources are known, accurate monitoring, reporting and verification protocols can be developed and tested. This has been done in sulfur dioxide (SO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>), and GHG source-based markets. In these markets technology developers and vendors are able to deal directly with the market segment that can directly apply the new technology. Vendors can benchmark their improved technology against existing technologies. Source-based measurement protocols tied to specific industries and technologies can provide high environmental integrity. In a market with environmental integrity each allowance surrendered accurately reflects one ton of equivalent GHG emissions. In a market where the allowances lack environmental integrity, either no inter-regional trading will occur or the prices of all allowances (or offsets) from that market will be discounted relative to prices for allowances (or offsets) in those markets that maintain a higher degree of environmental integrity.

#### Load-based market design

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<sup>26</sup> California Air Resources Board, Market Advisory Committee, Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California. Final Report, June 30, 2007. p. 23. Available at [http://www.climatechange.ca.gov/documents/2007-06-29\\_MAC\\_FINAL\\_REPORT.PDF](http://www.climatechange.ca.gov/documents/2007-06-29_MAC_FINAL_REPORT.PDF)



Under a load-based compliance scheme, LSEs will have to become expert on the protocols for measuring, monitoring and verifying GHG upstream emissions, since they will be held responsible for the environmental integrity of emissions. In fact, each LSE will need to ensure that each of its power suppliers accurately measures and verifies its GHG emissions. However, under a load-based design inherent inaccuracies will exist for all those transactions originating out-of-state that are assigned a generic or imputed GHG emissions rate and for those sources that are not required to track emissions with comparable accuracy to sources located in-state. This is due to the need to adopt an accounting scheme to impute emissions for purchased system power and for power transactions from unspecified generating units. This difficulty is compounded by the administrative infeasibility of tracking a very large number of transactions from source to load. In the CAISO control area alone, there are 15,000 transactions per hour with 99 load schedules and 800 to 1,000 custody exchanges per hour between market participants.<sup>27</sup> The number of transactions and the need to cross-check totals to verify emissions will grow exponentially with the number of LSEs participating, making the scale-up of the load-based market design to encompass the numerous LSEs and 34 control areas in the WECC multi-state region cumbersome, at best, if not impossible.

The lack of a direct link between imported energy and emissions and the corresponding lack of accountability are major failings of the load-based approach. Even if load-based GHG emissions are estimated for indexing purposes, the inherent inaccuracies will preclude effective verification and affect the value of load-based allowances throughout the western region.<sup>28</sup>

In general, the development and deployment of improved technologies will be enhanced by creating broad market segments that are not constrained by political boundaries or electricity market boundaries. A load-based market, which would be distinguished by at least two-tiers of *environmental integrity* (i.e., Tier 1 for in-state sources and Tier 2 for unidentified out-of-state sources selling power imported to California), presents barriers to cross-boundary trading. The lack of environmental integrity for emissions associated with imported power is likely to cause all of California's load-based allowances to be priced at a discount in comparison to prices in other markets where allowances have higher environmental integrity. The lack of environmental integrity for California's load-based allowances will inhibit allowance trading with other regions and, thus, restrict access to the combined market segments and higher volume and liquidity of allowance transactions desired by technology developers and vendors. Overall, the lower environmental integrity of a load-based design will reduce the financial and environmental benefits of market integration.<sup>29</sup>

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<sup>27</sup> Lonnie Rush & Kyle Hoffman, CAISO, Presentation to the CPUC on April 12, 2007.

<sup>28</sup> As just one example, only about 56 percent of emissions from imported electricity can be precisely identified, according to a 2007 CEC report: Alvarado, A and Griffin K. Revised Methodology to Estimate the Generation Resource Mix of California Electricity Imports: Update to the May 2006 Staff Paper. Sacramento, CA: California Energy Commission, 2007. Such a situation does not satisfy the requirements for environmental integrity.

<sup>29</sup> If inter-regional trading were to occur between a load-based market and a source-based market like RGGI or the EU ETS, the price of the load-based allowances at any given time would have to be discounted to





### First-seller/deliverer market design

For in-state resources, the first-seller approach provides the same *environmental integrity* as a source-based approach, because it is a source-based approach. However, first-sellers have the responsibility to assign GHG content to power they import, in a fashion similar to a load-based approach. Allocations and assignments by the first-seller/deliverer will be required, whenever more than one plant under contract to a first-deliverer provides power to the grid or when power is provided under contracts by unspecified plants or groups of plants.<sup>30</sup>

A first-seller approach, like the load-based approach, will have different levels of environmental integrity for in-state and out-of-state transactions. But, because the compliance responsibility is on the first-seller, verification may be more direct, and the overall environmental integrity of allowances in this market design should be somewhat higher than under a load-based approach. This, in turn, might make allowance trading easier between regional allowance markets, providing better market efficiency than under a load-based approach, but a less efficient market than would occur under a pure source-based approach.

### **Incentives for RD&D, Purchase & Utilization of Improved Technologies**

The presence of an emissions cap that declines over time will provide pressure to retire high emitting sources, like conventional coal-fired power plants, under all three cap and trade market designs. However, the choice of market design will have important effects on technology investment and development incentives.<sup>31</sup>

A source-based design will place the greatest direct pressure on individual sources, while the load-based design spreads compliance risk across each LSE's portfolio of power purchases. The current U.S. source-based cap and trade system for SO<sub>2</sub> has led to fuel switching and installation of a variety of flue gas desulfurization scrubbers and other improvements in the processes of power generation. The allowance market has worked well to minimize costs while ratcheting down emissions, but, by itself, has not funded sufficient RD&D to create the diverse technologies now in operation. Although the ability to reduce the costs of compliance has provided incentives to purchase and use improved technologies, the Department of Energy, the Environmental Protection Agency and the

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account for their lower verifiability and the reduced environmental integrity associated with imputed emissions.

<sup>30</sup> Although today's power contracts specify kWh, price, hours for delivery and delivery point, most contracts do not currently specify GHG emission rates/kWh. While the grid can deliver kWh at specific locations, it cannot deliver kWh with verified emissions content, unless each kWh delivered is tied contractually to a specific generating unit that is continuously monitored, measured and verified.

<sup>31</sup> The magnitude of research, development and demonstration funding needed to reach GHG reduction goals will require investment incentives beyond those provided by an efficient market-based GHG regulatory scheme. The chosen regulatory scheme will primarily influence the purchase and utilization of technologies needed to achieve compliance. Hence, it will also influence the investment and innovation needed to create the improved technologies.



Electric Power Research Institute, as well as manufacturers and vendors, have directly funded billions of dollars of RD&D intended to bring improved technologies to market. Thus, a combination of government and other funding incentives, including possible prizes for innovation and tax incentives,<sup>32</sup> plus the opportunity to make substantial profits will be needed to bring new technologies to market under all three cap and trade market designs. It should also be noted that worldwide technological innovation and the opening of new markets for U.S. technologies will be facilitated by the fungibility of emission allowances across different allowance markets, which will lead to greater opportunities for technology sales in markets around the world.

An LSE will not always be the most likely buyer of improved GHG reducing technologies, because some LSEs no longer own the power plants that serve their customers. Since LSEs are not individually adept at RD&D and cannot profit beyond their regulated rates of return, placing compliance responsibility on LSEs, rather than emission sources, will not motivate the R&D marketplace very much. Electric generators and electricity consumers are the market segments that should be directly targeted, and a source-based market is consistent with such direct targeting.<sup>33</sup> Likewise, when an electricity consumer sees the full costs of GHG reduction in its rates, the purchase of more efficient end-use technologies will become more attractive.

Under the load-based design there would be an ongoing misalignment of market incentives. After an initial rush of enthusiasm, vendors will not wish to spend time and money dealing with utility and regulatory bureaucracies, in order to develop and sell their products.<sup>34</sup> Without clear market signals backed up with allowances of known environmental integrity, technology investors will have less confidence in their ability to obtain the full value of their new technologies. Given more limited cost recovery and profit opportunities, it is more than likely that investors in clean technologies would be deterred by a load-based design. Overall, a load-based system will make it more difficult to “achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions ...,” which is a fundamental requirement of AB 32.<sup>35</sup>

### **Minimized Monitoring, Administrative, Transaction & Overall Costs**

A well-designed cap and trade market covering multiple sectors will enable market participants with different compliance costs to trade allowances within and across different

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<sup>32</sup> Investment and production tax credits, as well as emission taxes or fees can also play an important role, particularly in sectors without source diversity or where transaction costs for an allowance tracking system are high.

<sup>33</sup> Under any cap and trade system, the development of new resources will be supported by LSEs building new generation or contracting with new generation. Manufacturers will carry out R&D, and the amount of R&D will be a function of their perception of market opportunities, Renewable Portfolio Standards, tax credits and other subsidies.

<sup>34</sup> Some have argued that a load-based approach will encourage greater adoption of energy efficiency measures and renewable technologies. Since the CPUC in California currently mandates the adoption of energy efficiency measures and renewable generation technologies and can continue to do so, this is a debatable presumption.

<sup>35</sup> Assembly Bill No. 32, California’s Global Warming Solutions Act of 2006 (Sec. 38560).



market segments, and, hence, to minimize both transaction costs and overall costs to achieve a mandated level of state, regional or national GHG emissions. Competitive markets work best, when there are many buyers and many sellers, and when price signals are transparent and unfettered.

#### Source-based market design

The administrative costs for a source-based GHG market for electric generators are likely to be similar to those experienced in the U.S. SO<sub>2</sub> allowance program and in the European Union Emissions Trading Scheme. Continuous emissions monitoring, an allowance tracking system and compliance procedures have been tested and are manageable. Administrative costs would be borne by government and by the source and internalized in product prices, e.g., in wholesale electricity prices. Electric generators are already familiar with source-based emissions regulation and compliance processes. In addition, each individual GHG source is more likely to understand its own technology needs better than its customers, such as LSEs. However, at this point in time, the risks for building new natural gas and coal plants are large, since the future prices of allowances are uncertain.

Because transaction costs, as well as other costs, can be internalized in the price of power, builders and operators of new technologies will have the greatest opportunity to recover their costs and to generate profits. Since a source-based system is more favorable for investment in, development of and the application of new technologies, it is likely that overall costs of achieving long-term GHG reduction goals will be lower under a source-based design, depending on the rate of penetration of improved technologies.<sup>36</sup>

#### Load-based market design

The tracking and verification costs for this type of allowance system will be borne not only by LSEs, but also by sellers and sources that must supply continuous information regarding their emissions. In fact, the requirement of sellers and sources to pass nearly continuous information along with MWh sales would be more burdensome than under a source-based system. LSEs will work to find the lowest costs to comply with the rules, and these costs will be passed along in electricity rates. Because of the huge number and nature of electricity market transactions, it is doubtful that accurate tracking can occur from sources to LSEs. Therefore, imputed emissions will be used for transactions involving out-of-state sources.

In any event, the transaction costs associated with monitoring, tracking and verification would be highest under a load-based approach, where the number of transactions to be

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<sup>36</sup> In the short run, this may not be true for building combined cycle plants. Under a load-based cap and trade system, the utility can spread its compliance risk across many power plants. Under a source-based system, the plant developer bears the risks and the costs of acquiring allowances for a single plant or possibly multiple plants. However, under all market designs the plant operator/emissions source will bear the risks associated with plant performance and attainment of contracted or regulated target emission rates. Coal plant development without carbon sequestration would be expected to slow significantly and could come to a stop under cap and trade programs.



tracked will increase exponentially with the number of LSEs included in the program. Entities with little or no compliance experience, including middlemen, such as brokers, marketers and control area operators, such as the CAISO, and LSEs, such as Investor and Publicly Owned Utilities, Direct Access and Electric Service Providers, and Community Choice Aggregators will all become involved in the tracking and verification processes, even though only the LSEs will bear the compliance responsibility. Moreover, all electric power sources that emit GHG will need to accurately monitor, measure and allocate emissions to multiple power purchasers, so that downstream tracking can occur.

Proponents of a load-based system in California claim that only 55-60 LSEs would need to comply under a load-based system for California. However, they forget that the monitoring, allocation and tracking begins with emission sources, which would still need to be a part of an accurate GHG monitoring, tracking and verification system. Instead of supplying emissions information to one agency, like the U.S. Environmental Protection Agency or the California Air Resources Board, GHG sources operating under a load-based system would have to allocate emissions in real-time to all their power purchasers, who, in turn, must supply and verify that information to control area operators, marketers and brokers and, ultimately, to LSEs. This compliance burden can be legally mandated for sources within California. However, for sources outside California power purchasers would need to impose GHG monitoring and reporting requirements contractually or rely on imputed emission factors. As previously discussed, imputed emission factors are inherently inaccurate, and it has been pointed out that their use would restrict market transactions and give rise to perverse incentives for both clean and dirty generating units.

Since load-based transaction costs will be significantly higher and cost recovery for new technologies will be more problematic, there is likely to be a less favorable investment environment for cleaner technologies under a load-based system. Renewable resources will do fine under any cap and trade system, since they don't need to trade or acquire GHG allowances and can reduce the demand for allowances. Natural gas-fired combined cycle generating units would have contractual requirements under both market designs, as would other fossil-fired generators. Given the very high monitoring, administrative and verification costs and the relatively more limited number of entities for trading, the overall costs of achieving a given level of GHG reduction are likely to be higher under a load-based system. Furthermore, due to the assumptions regarding imputed emissions for imported power, there will be more uncertainty regarding the amount of reductions actually achieved.

#### First-seller/deliverer market design

The transaction costs and other costs of this approach are likely to be less than under a load-based design and greater than under a source-based approach. However, since transaction and other costs can be internalized in this design, investors should be more willing to develop and install cleaner technologies than under a load-based system. An expanded first-seller market that includes an increasing number of western states would look more like a source-based approach, since fewer sources would be excluded and, presumably, imputed emissions would be estimated more accurately, if only a very limited



number of generators in the WECC remain outside of those states that adopt a first-seller market approach.<sup>37</sup>

### **Enhancement of Environmental Justice Goals**

Most power plants in populated urban locations provide essential reliability and peaking services. Hence, power plants will continue to be needed in urban locations, most likely at existing plant sites, where environmental justice concerns are high, but siting alternatives are low.

Existing urban power plants tend to be older and less efficient, and they burn fossil fuels (natural gas in California). Because the global impacts of GHG emissions or emission reductions are not affected by their location, these urban plants might be good candidates for cheaper GHG reductions measured on the basis of \$ per tonne of GHG reduced. Thus, under a cap and trade system these less efficient plants could be targeted for early replacement by new, lower emitting technologies.<sup>38</sup>

For the most part, the environmental justice community has advocated command and control regulation of GHG, in order to reduce the other pollutants released by urban power plants. However, the source-based cap and trade approach using GHG allowances for compliance, along with accompanying technology incentives, is more likely to lead to the earlier replacement of urban power plants by advanced generation technologies than would occur under a load-based market design.

### **Simplicity of Rules and Ease of Enforcement**

A workable market design will require a system for enforcement, including penalties for emissions exceeding the allowances surrendered and for faulty measurement or misreporting emissions. Under a source-based market design the generator/emissions source will be responsible for measurement, reporting and allowance compliance. With a load-based or a first-seller/deliver market design, the LSE or the seller/deliver would likely have contractual arrangements that ensured they would not be held responsible for violations by the generator. Generators would still need to measure and report emissions content to market intermediaries, which would then pass on this data to the LSE or the first-deliverer. As discussed above, the assignment and verification of emissions is far simpler under a source-based approach. Unique allocation and verification may not be feasible or practical under either the load-based or first-seller/deliverer approaches.

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<sup>37</sup> In a pure source-based approach, generators/GHG sources located outside regulated states would be ignored, thus avoiding the need to impute emissions altogether. As the boundary of a first-seller approach expands to include an increasing percentage of all the fossil-fired generators in the WECC, the first-seller market design behaves increasingly like a source-based design.

<sup>38</sup> While a low GHG emissions standard measured in maximum lbs./MMBtu or tonnes/MWh is unlikely to be achievable at older, inefficient power plants, such plants can provide relatively cheap GHG reductions, when measured on the basis of \$ per ton GHG removed. Nevertheless, because older gas steam power plants operate infrequently and will be needed for load following, it is also possible that these older facilities will remain in service, despite their relatively higher GHG emission rates.



Certainly, enforcement would be easiest and transaction costs would be lowest with a source-based market design.

### **Acceptable Magnitude and Likelihood of Unintended Consequences**

As experience has demonstrated, over-regulated markets are prone to unintended consequences, since the desire to control market outcomes can lead to undesirable effects. California has only to look back to the years 2000 and 2001 to realize that poor regulatory designs can have serious adverse effects, leading to consequences that may have been foreseeable, but were certainly unintended.

Even after clean technologies are installed, the market incentives in a load-based system, which must rely on imputed emission rates for imported power, will be misaligned. As pointed out, because clean imported power from unspecified resources would be assigned an imputed emissions rate, generating technologies that are cleaner than the imputed rate may prefer to operate under bilateral contracts, in order to get paid for being cleaner, rather than making spot market sales at the higher imputed emission rates. The operational incentives under a load-based market are also perverse, since under MRTU, LSEs will not be able to control the dispatch of some higher emitting, but lower cost power plants, which need not include allowance costs in their wholesale prices. In addition, the lesser number of LSEs may enable some LSEs to exert undue market power during adverse market conditions, such as a low hydro year.<sup>39</sup> Furthermore, unless there is also source-based regulation for in-state resources to go along with the load-based system, it would be possible to “launder” dirty in-state emissions by selling to or exchanging dirty power with out-of-state buyers and replacing it contractually with cleaner generation, such as Pacific Northwest hydro or imputed emissions from non-specific resources. Here again, a tracking and verification nightmare emerges under a load-based system.

An assessment of the unintended consequences, including market manipulation, which might arise under these different market designs, is beyond the scope of this paper. Nevertheless, the likelihood and magnitude of possible unintended consequences should be thoroughly examined before a particular market design is adopted.

### **Timely Transition to a Regional or National Market System and Scalable in Size**

In a load-based market the difficulties of measuring, allocating, tracking, aggregating and verifying emissions for power sold to LSEs would grow exponentially as more and more LSEs and transactions are included. Hence, a load-based approach can not be practically scaled up to regional or national levels. In contrast, a source-based approach can be scaled up, since the responsibilities lie with each regulated source. As the size of the geographic region approaches the size and coverage of the WECC, a first-seller/deliverer market

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<sup>39</sup> In past years low hydro conditions in California and the West have increased fossil-fired generation in California by as much as 25 percent above average hydro conditions.



design will behave increasingly like a source-based market. Currently, all major proposals for U.S. national cap and trade legislation rely on a source-based market design.<sup>40</sup>

There are also many questions concerning the dismantling of load-based compliance systems and the timely transferability of load-based allowances into a national source-based allowance system. The difficulties in doing this were amply displayed by the U.K., when it closed out its load-based system and moved to the source-based EU ETS. Maintaining two different regulatory systems would be unnecessarily costly, so a transition to a U.S. national system should be anticipated.

### **Satisfies AB 32 in California**

California's Assembly Bill 32, passed in 2006, requires broad-based, multi-sectoral emissions reductions to achieve GHG emissions goals.<sup>41</sup> Depending on how it is implemented, each cap and trade market design discussed here would encompass both in-state generated emissions and out-of-state emissions associated with power imports, and each could satisfy AB 32. But, without the timely cooperation of other states and affected out-of-state entities, none of these designs will be able to satisfy the intent of AB 32.

## **4. CONCLUSIONS**

In the comparisons presented above, we discussed the capabilities of each market design to achieve the following important market objectives:

- Clear market price signals,
- Uniform and stable GHG allowance prices,
- Verified environmental integrity,
- Sufficient incentives for RD&D, purchase and use of improved technologies,
- Minimized monitoring, administrative, transaction and overall costs of compliance,
- Enhancement of environmental justice goals,

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<sup>40</sup> A cap and trade market that operates on a national scale will also provide greater opportunities for federal tax incentives and for technology RD&D policies to complement the incentives provided by the value of the allowances freed up by reducing GHG emissions.

<sup>41</sup> Assembly Bill No. 32, California's Global Warming Solutions Act of 2006, requires the state Air Resources Board to adopt regulations for reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with a specified program. The bill mandates a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020, and requires the state board to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions, as specified. The bill authorizes the state board to adopt market-based compliance mechanisms, meeting specified requirements. The bill requires the state board to monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board, pursuant to the specified provisions of existing law. The bill also gives the state board the authority to adopt a schedule of fees to be paid by regulated sources of greenhouse gas emissions.



- Simplicity of rules and ease of enforcement,
- Acceptable magnitude and likelihood of unintended consequences,
- Scalable in size and enables a timely transition to a large regional or national market, and in California
- Satisfies the requirements of AB 32.

A regulated source-based market is more likely to achieve the above objectives than the other two market design options. With respect to technology incentives, the comparisons show that a source-based market with its clearer valuation of competitive allowance prices and its better internalization of costs in market prices would provide better incentives for the development and application of new technologies than either a first-seller/deliverer approach or a load-based design. In turn, a first-seller/deliverer approach is preferable to a load-based approach.

Several reasons why a source-based market design should be preferred are:

- 1) A source-based market design is simpler, and its implementation will have lower costs and lead to faster implementation.
- 2) Load Serving Entities are less likely to make investments in innovative or improved supply side technologies to reduce GHG emissions than are the emissions sources themselves.
- 3) Source-based emission reductions can be more accurately tracked and verified. In any case the responsibility for monitoring and accurate reporting will be placed on emissions sources, even if a load-based market design is adopted.
- 4) The environmental integrity of emissions allowances is greater in a source-based market than in a first-seller/deliverer market, which in turn, is higher than in a load-based market.
- 5) Emissions allowance price signals emanating from LSEs in a load-based market will be adulterated and passed imperfectly both upstream and downstream, as compared to more direct price signals in either a source-based or first-seller/deliverer allowance market.
- 6) Incentives to purchase and utilize improved, lower emitting technologies will be greater under a source-based approach than under either the load-based or the first-seller deliverer approaches,<sup>42</sup> and
- 7) The transition to a national source-based cap and trade market will be easier, faster and less costly, if states adopt a compatible source-based approach.

Because of its similarities to a source-based market, particularly as its geographic coverage expands, the first-seller/deliverer approach is more likely to function competitively and

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<sup>42</sup> The incentives are better, partly because there are fewer gaming opportunities for achieving compliance under a source-based cap and trade system. The adverse selection for generating sources under a load-based system will also reduce the environmental integrity of all allowances in a load-based system, potentially reducing the prices of such allowances in interregional or international trading.





keep overall costs lower than a load-based approach. The strengths and shortcomings of source-based markets have been tested in practice, while there are many shortcomings of the load-based approach that make this market design unworkable, more costly and not scalable up to multi-state coverage levels.<sup>43</sup> The first-seller/deliverer approach is a hybrid of these two market designs, such that its expected impacts lie in between those expected under the two alternatives.

Under the load-based design there will always be a misalignment of market incentives. Vendors do not wish to spend time and money dealing with utility and regulatory bureaucracies, in order to develop and sell their products. Without clear market signals backed by allowances with established environmental integrity, technology investors will have less confidence in their ability to obtain the full value of their new technologies. Given more limited cost recovery and profit opportunities, it is more than likely that investors in clean technologies would be deterred by a load-based design. Moreover, the adoption of a load-based system will make it more difficult to “achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions ...,” which is a basic requirement of California’s AB 32.<sup>44</sup>

In summary, the foregoing comparisons show that a load-based system would be more complex, costly and inaccurate than either a source-based or a first-seller system. Trying to institute a regional load-based cap and trade system and failing to achieve the fundamental market objectives would set back public confidence in any carbon emissions reduction scheme. On the other hand, technological innovation will be driven by the greater value that can be realized under source-based and first-seller/deliverer market designs.

Therefore, we recommend the adoption of a regional and, ultimately, a national source-based cap and trade GHG allowance system. To comply with Assembly Bill 32, passed in 2006, we recommend that California and other western states adopt an integrated source-based cap and trade system with broad enough geographic coverage to include most of the power sources now serving California and other western LSEs. As a second choice, which would incur unnecessary costs prior to the transition to a national cap and trade system, we recommend that California and other western states adopt a first-seller/deliverer market design with provisions for replacing it with a regional or national source-based system, as soon as possible.

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<sup>43</sup> As discussed elsewhere, the load-based market design envisioned in California will be infeasible and unworkable for numerous reasons. See, for example, Van Horn Consulting, [Comments on the Market Advisory Committee’s Draft Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California](#). Submitted to the California Air Resources Board, June 12, 2007.

<sup>44</sup> California Assembly Bill AB 32 (Sec. 38560), 2006.

