Knowing Your Power

Improving the Reporting of Electric Power Fuel Content in California

By
Steven Weissman
Senior Policy Advisor
Center for Sustainable Energy[1]

"There is a need for reliable, accurate, timely and consistent information regarding fuel sources for electric generation offered for retail sale in California."[2]

That is what the California Legislature said, 20 years ago, when it enacted Senate Bill (SB) 1305 (1997) that required utilities and other retail providers to disclose sources of electric generation. This came a year after the passage of Assembly Bill (AB) 1890, which allowed for retail competition in electricity markets. At the time, the fuel content law no doubt was prompted by a desire to verify the claims of various retail providers as to the environmental benefits of choosing their service over others. Later, the Legislature added the objective of understanding the greenhouse gases associated with the delivered power.[3] The Power Content Label, issued by each retail provider on an annual basis, offers an opportunity to hold retailers accountable for the impacts of their power choices. It also could help consumers to be better informed as they choose a provider and improve their understanding of the implications of using power in one part of the day versus another.

The Power Content Label, issued by each retail provider on an annual basis, offers an opportunity to hold retailers accountable for the impacts of their power choices.

1 This report would not have been possible without the critical contributions of former Center for Sustainable Energy team member Christina Machak and UC Berkeley graduate student Laura Sanchez. Thanks also to those inside and outside of the center who offered their comments and suggestions.
2 California Stats. 1997, Ch. 796, Sec. 1.
3 Cal. Pub. Util. Code Section 398.1(b).

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The Problem

The Power Content Label provides too little information about the fuels powering the grid and no information at all about what fuels are being used at any given time. This is a problem because it leaves electric power providers less than fully accountable for the power purchase and delivery decisions they make. In addition, although customer choice of retail providers is now quite limited, the current Power Content Label fails to help customers who do have a choice to make well-informed decisions, and it fails to properly inform consumers large and small about the greenhouse gas implications of their power use decisions. Further, understanding the times at which various sources are being used to power the grid is increasingly important as regulators make decisions about when to encourage people to use power for such purposes as charging electric vehicles.

Why Californians Face This Problem

The law, as amended in 2009,[4] allows retailers to characterize a portion of their power as coming from "unspecified" sources. Statewide, that represents more than 14 percent of the delivered electricity; for Southern California Edison, that number has exceeded 40 percent.[5] And the power in this category is not just any electric generation – the unspecified category is dominated by imported power that is likely to include output from the dirtiest generators serving California markets.

In addition, while the law authorizes the California Energy Commission to collect data about generation from every power plant on an hourly basis, it only requires retail providers to tell their customers about annual average usage of each fuel type. Perhaps equally important, the Energy Commission does not perform an audit to ensure the accuracy of the information it is providing.

Power supply decisions made by retailers have significant environmental and climate consequences. Yet, few stakeholders are motivated to do a more complete job of reporting on fuel content. Arguably, retailers don't want to be required to account for all their power purchase decisions and dirtier out-of-state generators don't want to identify themselves as it could lead to lower sales, and none of the market participants — including the California Independent System Operator — want to take on the added work of creating accurate, detailed accounting for each power purchase transaction. Further, retailers have successfully argued that any disaggregation of the annual fuel averages by season, month or day of the year would enable some generators to gain a competitive advantage by allowing them to infer the marketing strategies of others.[6]

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4 California Stats. 2009, Ch. 313, Sec. 2.

5 See Southern California Edison Power Content Label for 2015, including statewide comparison http://www.energy.ca.gov/pcl/labels/2015_labels/Southern_California_Edison.pdf.

6 This is a specious argument, given the various ways in which a generator or market seeking a market advantage could aggregate information from existing sources to better understand competitors' behavior. In addition, unless competitors could see each other's bids as submitted in formal markets (a change which no one is suggesting), the ability to discern a competitor's market strategy is minimal. Finally, even with more specific fuel type disclosure, the data would remain aggregated by fuel type, allowing for considerable anonymity in most jurisdictions.

This report provides the history of the Power Content Label in California, explains the problems with the existing approach, analyzes the reasons for the current limitations and the advisability of improving the process, and offers suggested next steps.

This leaves it to the Legislature to require more detailed reporting and to regulators to make sure it happens. This report provides the history of the Power Content Label in California, explains the problems with the existing approach, analyzes the reasons for the current limitations and the advisability of improving the process, and offers suggested next steps.

Why the Power Content Label Is Important

A series of Legislative actions, beginning in the late 1990s, created and subsequently amended the Power Source Disclosure program in California.

In 1997, **Senate Bill 1305** created the Power Source Disclosure program,[7] which required each retail electricity provider to disclose to its customers on an annual basis the fuel source of electricity it purchases or owns to serve its load. The aim of the program is to provide "accurate, reliable, and simple-to-understand information on the sources of energy that are used to provide electric services."[8] Figure 1 provides a typical Power Content Label.

Figure 1: Power Content Label

POWER CONTENT LABEL

ENERGY RESOURCES	2014 POWER MIX	2014 CA POWER MIX**
Eligible Renewable	32%	20%
Biomass & waste	7%	3%
Geothermal	2%	4%
Small hydroelectric	4%	1%
Solar	12%	4%
Wind	7%	8%
Coal	10%	6%
Large Hydroelectric	8%	6%
Natural Gas	38%	45%
Nuclear	0%	9%
Other	0%	0%
Unspecified sources of power*	12%	14%
TOTAL	100%	100%

* "Unspecified sources of power" means electricity from transactions that are not traceable to specific generation sources.

** Percentages are estimated annually by the California Energy Commission based on the electricity sold to California consumers during the previous year.

For specific information about this electricity product, contact:	**Sample** 555-555-5555
For general information about the Power Content Label, consult:	California Energy Commission 1-844-217-4925 http://www.energy.ca.gov/pcl/

Assembly Bill 162, which passed in 2009, significantly revised the original Power Source Disclosure Program. The most substantial change was the addition of a category for unspecified power. Prior to 2009, in addition to reporting on specifically identified power sources as it does now, the California Energy Commission's Electricity Analysis Office also assigned a regional

7 http://www.energy.ca.gov/pcl/documents/SB1305REG.PDF.
8 Cal. Pub. Util. Code, op. cit.

generation mix to the remaining imports from the Northwest and Southwest regions of the Western Electricity Coordinating Council (WECC). Based on the general characteristics of power from those two regions, Power Content Labels appeared to identify the fuel sources for all the power that a given retailer furnished to its customers. But since the passage of AB 162, retailers have been allowed to report purchases in a category called "unspecified," revealing nothing about the fuel used to generate the related power.

Figure 2: Southern California Edison Power Sources 2009-13

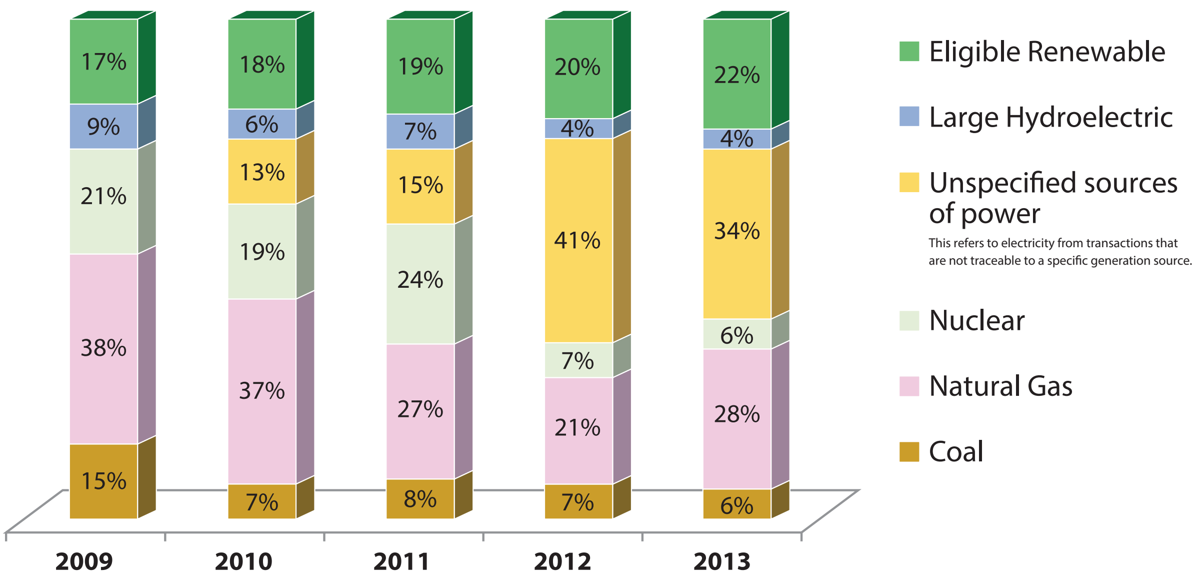


Chart from SCE illustrating the change in reporting with the introduction of the unspecified sources of power in 2010 as required by AB 162.

California Assembly Bill 1110, which passed in 2016, amended the California Public Utilities Code Section 398 to "...require the Energy Commission, in consultation with the California Air Resources Board (CARB), to adopt a methodology for the calculation of greenhouse gas emissions intensity for each purchase of electricity by a retail supplier to serve its retail customers." The aim of the bill, as stated by the commission, is to "improve transparency for customers and strengthen the Power Source Disclosure program's relevance to climate change activities in California."[9] In 2018, the Energy Commission plans to enact new rules in response to the legislation. The staff has issued proposed rules that would improve one aspect of the power content reporting process – the way that the reports characterize renewable energy credits (as further discussed). However, AB 1110 cannot achieve its aim of increased customer transparency without better power source accounting by both the Energy Commission and the utilities. In the absence of more accurate accounting, many load-serving entities (LSEs) will be reporting a systemwide average emissions factor for a large portion of their service. In fact, the bill could create perverse incentives for utilities to obscure purchases of generation from coal and natural gas-fueled power plants by classifying them as unspecified power to reduce their reported emissions factor. In addition, there are inconsistencies in reporting by the LSEs and Energy Commission, as discussed in more detail in the following sections.

> …AB 1110 cannot achieve its aim of increased customer transparency without better power source accounting by both the Energy Commission and the utilities.

9 http://www.energy.ca.gov/pcl/.

California Assembly Bill 79, introduced in 2017, would have required the CARB to update its methodology for calculating greenhouse gas emissions from unspecified sources of electricity and the California Independent System Operator (CAISO) to report to the Legislature on its ability to break down greenhouse gas emissions on an hourly basis. The Legislature passed a watered-down version of the bill, but it was vetoed by Governor Jerry Brown.

Current Definitions of Unspecified and Specified Power

California Public Utilities Code Section 398.2(d), as amended by AB 1110 defines specified sources as: *Electricity transactions that are traceable to specific generation sources by any auditable contract trail or equivalent, such as a tradable commodity system, that provides commercial verification that the electricity source claimed has been sold once and only to a retail consumer.*

Public Utilities Code Section 398.2(e), as amended by AB 1110, defines unspecified sources as: *Electricity that is not traceable to specific generation sources by any auditable contract trail or equivalent, including a tradable commodity system, that provides commercial verification that the electricity source claimed has been sold once, and only once, to a retail consumer.*

Power Disclosure Calculations in California

There are two power disclosure calculations performed by the California Energy Commission (with data assistance from CAISO and the LSE): "total system electric generation" and the "Power Content Label." While these calculations rely on some of the same data sources they are derived by different analysts, using different methodologies and some different data. A step-by-step description of each methodology is outlined in Appendix A.

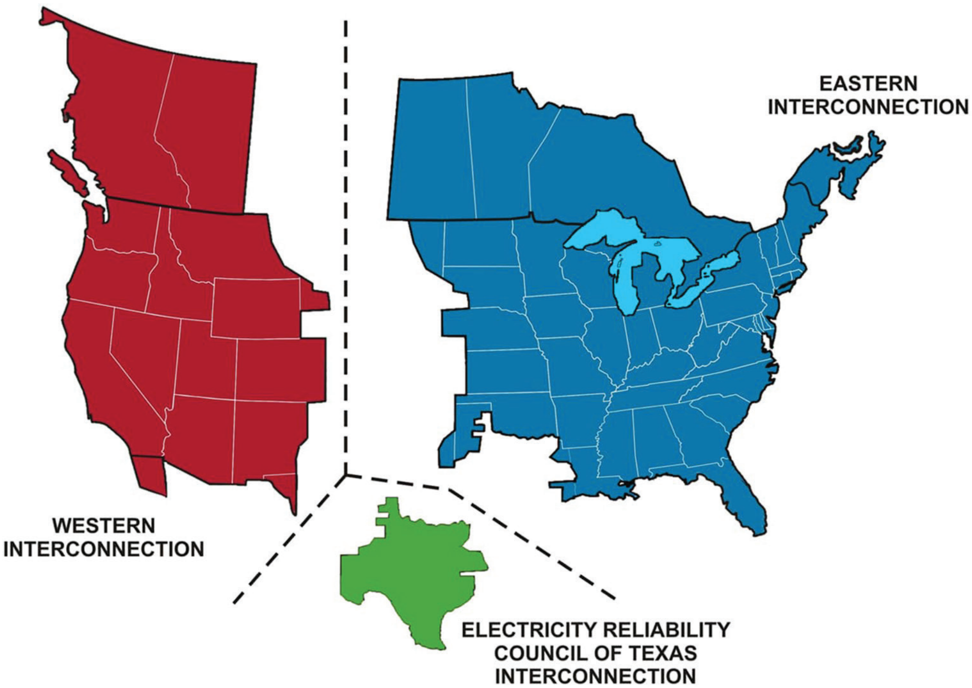
Organized Electricity Markets

Organized markets are managed by independent system operators (ISOs) or balancing authorities. These are the entities responsible for balancing the demand and supply of electricity for a specific area.[10] There are 35 balancing authorities in the Western Electricity Coordinating Council (WECC), one of the three electric system interconnections in the contiguous 48 states (Figure 3).[11]

10 "U.S. electric system is made up of interconnections and balancing authorities," U.S. Energy Information Administration, accessed March 14, 2017, https://www.eia.gov/todayinenergy/detail.php?id=27152.

11 "California imports about a quarter of its electricity on average," U.S. Energy Information Administration, accessed March 14, 2017, https://www.eia.gov/todayinenergy/detail.php?id=30192#tab3.

Figure 3: North American Electric Interconnections



Source: U.S. Department of Energy

WECC is divided into three subregions.[12]

1. The California region, which has five balancing authorities including the California Independent System Operator.

2. The Northwest region, which includes most of Colorado, Idaho, Nevada, Montana, Oregon, Utah, Wyoming, Washington and a small area of northern California.

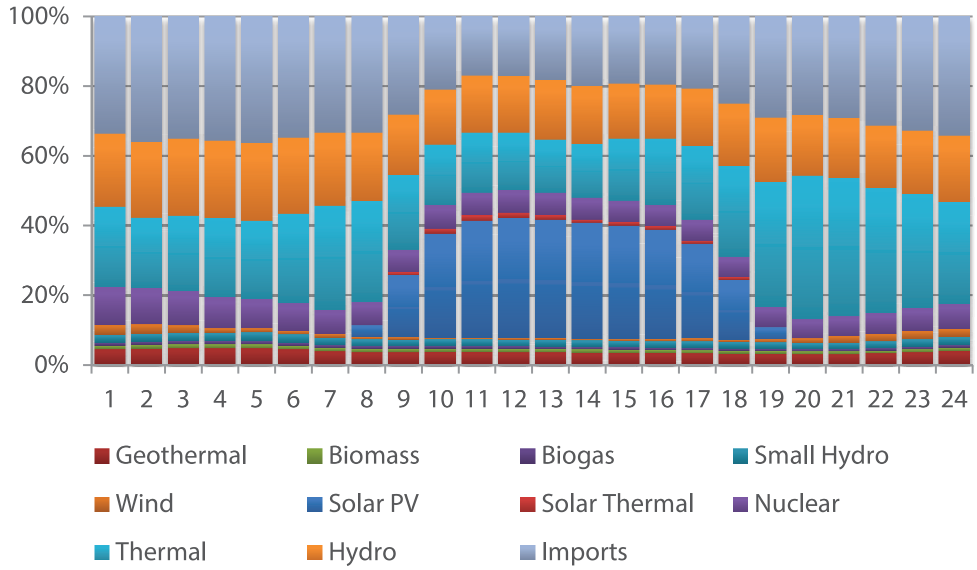
3. The Southwest region, which includes much of Arizona, New Mexico and small portions of Nevada and Texas.

The California Independent System Operator (CAISO) oversees day-ahead and hour-ahead power markets. As is the case with ISOs and regional transition organization in other parts of the country, the CAISO also serves as a balancing authority, managing the flow of electricity across 80 percent of the state's power grid.[13]

CAISO reports hourly output data, breaking down the power that flows within its network between renewables (geothermal, biomass, biogas, small hydro, wind, solar PV, solar thermal, nuclear, other thermal, hydro and imports. Figure 4 shows the hourly breakdown of total production by resource type for the day 3/13/2017.

12 Ibid.
13 "ISO Basics" (California ISO, n.d.), http://www.caiso.com/Documents/ResourceInterconnectionFAQs.pdf.

Figure 4: CAISO Hourly Production by Resource Type for 3/13/2017



Source: Data taken from CAISO's website.

There are no large-scale coal-fired power plants in California, but there are many in other parts of the West. Historical policies, therefore, may sometimes encourage consumption when the likelihood of using coal-fired power is greatest.

As Figure 4 shows, imports represented between 17 percent to 36 percent of the total breakdown for 3/13/2017, or 28 percent on average. Imports are highest between 6 p.m. and 8 a.m., when there is no or little solar power generation. However, long-standing policies have encouraged power consumption at night, during what have traditionally been called off-peak hours. CAISO data shows that imports are higher during those times. There are no large-scale coal-fired power plants in California, but there are many in other parts of the West. Historical policies, therefore, may sometimes encourage consumption when the likelihood of using coal-fired power is greatest. The failure to specify the power sources for those imports and break down those quantities by time-of-today arguably made it easier for customers and regulators to disregard the practical effect of encouraging customers to shift load to the nighttime.

It is possible that some portion of the unspecified imports come from coal-fired power plants east of California. Would a comparison of California import and coal plant production data for the same day show complementary patterns? The problem is, we simply do not know and cannot know based on public data that is currently available. However, we should want to know to be sure that a given retailer's power supply decisions are not unnecessarily increasing the retailer's carbon footprint.

The Challenges

Categorizing some power as "unspecified" and using a static proxy for carbon emissions masks the greenhouse gas consequences of load-serving entities' power purchase decisions.

AB 1110 amended section 398.5 of the Public Utilities Code to require retail suppliers to report to the Energy Commission "the kilowatt-hours purchased from unspecified sources in California and from unspecified sources imported into California from other subregions within the Western Electricity Coordinating Council."

While the increased disclosure is a step toward improving transparency, the designation of greenhouse gas emissions from regions outside of California relies on an inflexible proxy, unlikely to reflect actual emissions at any particular time. The CARB uses a default emissions factor of 0.428 MT of CO2e/MWh (metric tons of carbon dioxide equivalent per megawatt-hour) as a proxy to calculate the emissions related to the "unspecified sources of power."[14] This factor was calculated using 2008 data for the WECC according to data provided by the U.S. Energy Information Administration (EIA) and has not been updated in recent years to reflect current grid conditions.[15]

The default factor assumes identical GHG emissions for imports from different geographic regions even though the mix of resources constituting "unspecified" power can vary significantly throughout the portions of the Western grid that supply California. The California Energy Commission has recognized that "much of the Pacific Northwest spot market purchases are served by surplus hydro and newer gas-fired power plants. The Southwest spot market purchases would be comprised of new combined cycle power and some coal."[16] Unfortunately, none of these differences are currently reflected in the approach to measuring GHG emissions for electricity that serves California customers.

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By using a default proxy regardless of the time of the year or day, this methodology inaccurately quantifies the GHG emissions associated with unspecified sources of power under the PCL. As described above, Assemblyman Marc Levine introduced AB 79, which originally would have required balancing authorities to report to the CARB all relevant information necessary for the purpose of adopting a methodology to properly calculate hourly emissions of greenhouse gases associated with electricity reported as "unspecified sources of power."[17] In response to concerns from various stakeholders, Levine amended the bill to require efforts by the CAISO to improve the accuracy of calculations, but did not require the adoption of specific changes. AB 79 shined a bright light on the need for better information, but the current challenges will likely not be overcome in the absence of a more specific mandate. Ultimately, Governor Jerry Brown vetoed the bill, calling it unnecessary.[18]

14 Joe Kaatz, "AB 79: Quantifying Hourly GHG Emissions from Unspecified Electric Generation Sources," The EPIC Energy Blog, March 29, 2017, https://epicenergyblog.com/2017/03/29/ab-79-quantifying-hourly-ghg-emissions-from-unspecified-electric-generation-sources/.

15 Ibid.

16 http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html.

17 "AB-79 Electrical Generation: Hourly Greenhouse Gas Emissions: Electricity from Unspecified Sources," California Legislative Information, accessed March 15, 2017, http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB79.

18 http://gov.ca.gov/docs/AB_79_Veto_Message_2017.pdf.

The reporting practices of load-serving entities related to their use of unbundled renewable energy credits (RECs) mask the carbon content implications of using those credits.

The purchaser of an unbundled REC can claim the renewable quality even though another source of power is used to serve its customers. Since it would make no sense to use a REC if the other source of power were renewable, the power underlying the REC may be power generated by coal or natural gas.

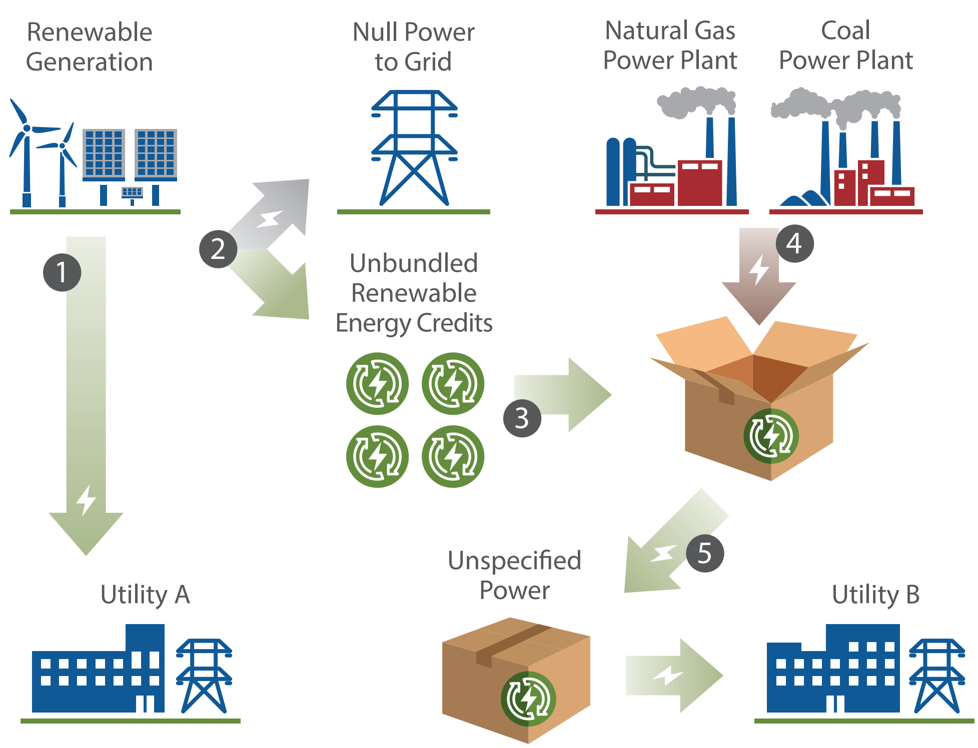
A REC is a certificate used to demonstrate compliance with the obligation of LSEs under the renewable portfolio standard (RPS) program to furnish a certain portion of their power from qualifying renewable sources. It also is used by some providers of voluntary renewable energy products to support claims that they are purchasing their electricity from zero GHG and renewable resources. LSEs must take delivery of the renewable power needed to meet most of their RPS obligations. However, they can meet a portion of their obligations by purchasing unbundled RECs. These unbundled RECs represent transactions for which a qualifying renewable generator sells its energy output to one LSE and the renewable quality of that power to another. The purchaser of an unbundled REC can claim the renewable quality even though another source of power is used to serve its customers. Since it would make no sense to use a REC if the other source of power were renewable, the power underlying the REC may be power generated by coal or natural gas.

LSEs also purchase RECs as part of "firmed and shaped" products tied to out-of-state renewable generation. These transactions involve the purchase of unspecified energy completely unrelated to the renewable generation being claimed. The unspecified energy can be delivered at a different hour or season and can be sourced from a completely different subregion of the WECC.

Currently, in reporting their power content, LSE's assume that any power source supported with unbundled RECs is renewable and carbon-free. The Energy Commission staff's AB 1110 proposal, if adopted, would end this practice. Here is an example of why this change is critical to enable customers to understand the consequences of the LSE's power purchase decisions.

Figure 5: Unbundled Renewable Energy Credits Can Lead to Unaccountable Power Choices

Utility A buys renewable power delivered to the California grid (1) and retains fully bundled renewable energy credits related to that power. The same renewable energy provider sells unbundled renewable energy credits associated with renewable power it did not sell to Utility A (2). The power from which those unbundled credits are derived is delivered into the grid and characterized as null power (2). Utility B buys some of the unbundled renewable energy credits (3) as well as actual coal and natural gas-generated power (4) to deliver to its customers. Utility B can package its unbundled credits with the coal and natural gas-fired power, call its power renewable (5) and claim no greenhouse gas emissions. Utility B is not held accountable for the greenhouse gas emissions resulting from its electric service.



Failing to break down average fuel types by hour of the day leaves customers unable to understand the environmental implications of different usage patterns

Should customers charge electric vehicles or run major appliances in the middle of the day or in the middle of the night?

Policymakers generally attempt to influence customer behavior using time-differentiated rates, such as time-of-use or real-time pricing. By the end of 2019, all of California's regulated utility residential customer will receive service with time-of-use rates, unless they choose to continue using a more traditional rate structure. A time-of-use rate involves charging more for electric service during periods of high usage and less during periods of low usage. An exception to this strategy is that as more and more solar and wind power are available in the middle of the day, time-of-use periods can be structured to encourage more usage when the sun shines, even during periods when the demand for electricity is high.

The time-of-use signal conveys information to customers about price, but not about the fuel content of the power purchased at any given time. A Power Content Label that includes an hour-of-the-day breakdown could help customers better understand the environmental implications of various patterns of usage. In addition, such a breakdown would make load-serving entities more accountable for their power procurement decisions, as well as their rate design proposals.

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An Example of All-generation Attribute Tracking – New York

Since 1998, the New York State Public Service Commission has been helping LSEs report generation as part of the Environmental Disclosure Program. The current system relies on a "conversion transaction" to assign previously unspecified energy to an LSE. The transaction occurs between one seller and one buyer who have both participated in the NY-ISO spot market within the previous trading quarter.[19] The two actors work together to identify a packet of energy, which can then be disaggregated from the total unspecified energy sold in the spot markets for environmental disclosure reporting. Market participants are responsible for arranging these transactions, but many rely on third-party brokers to set them up.

At the end of each quarter, spot market transactions claimed by conversion transactions are disaggregated from the total of power purchased by New York LSEs in the sport market. The fuel mix of the remaining power is then calculated and assigned to the spot market participant purchasers who did not arrange conversion transactions. This system results in power source and emissions disclosures by LSEs in New York that do not include any line item for unspecified power.

This program is expected to be improved by the New York Generation Attributes Tracking System (NYGATS), a recently completed online certificate-tracking system that records information about electricity generated, imported and consumed within New York State. Design of this system[20] began in 2012

19 http://www3.dps.ny.gov/W/PSCWeb.nsf/All/280E6633FF4A527585257964004FA40E?OpenDocument.
20 https://www.nyserda.ny.gov/All-Programs/Programs/NYGATS.

after Governor Andrew Cuomo signed into law Bill No. A06114, which directed the New York Energy Research and Development Authority (NYSERDA)[21] and the New York Public Service Commission to research and develop a system for tracking energy generated and consumed in the state. NYGATS issues unique serial numbers to track and manage energy attribute certificates and renewable energy certificates. These certificates account for each MWh of electricity generated and imported into New York.

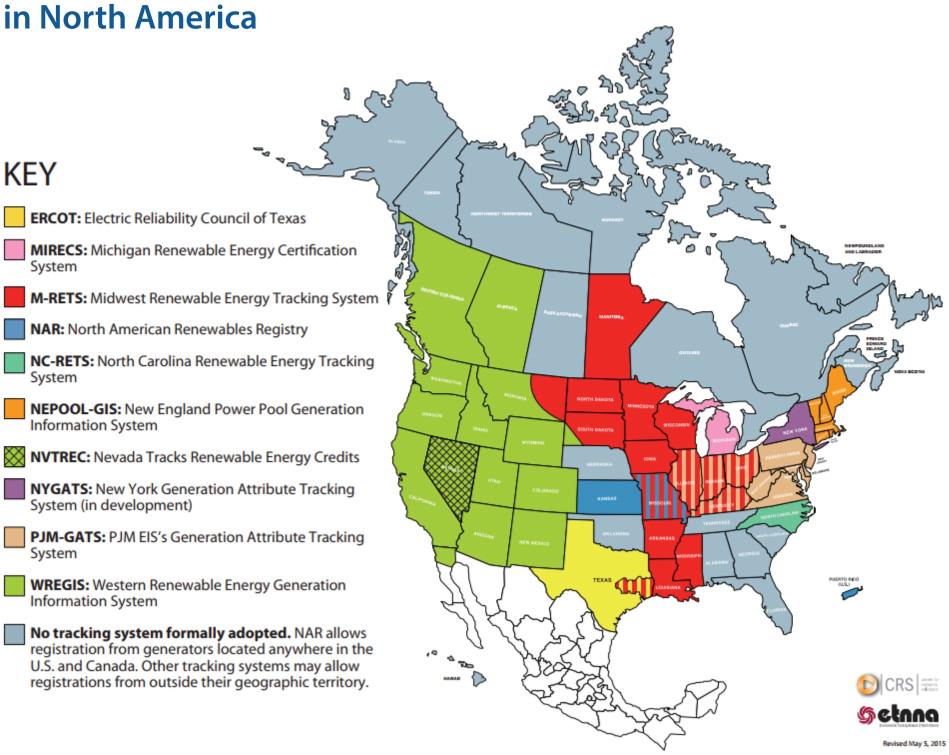
Generators, energy service providers, aggregators, green power markets and consumers all use the NYGATS system. The system has been designed to record a full audit trail of power traded in the NYISO wholesale markets, which should prevent double counting of RECs and improve public reporting. In the United States, only New York and New England offer full generation attribute tracking systems. All others, including the Western Renewable Energy Generation Information System (WREGIS), of which California is a part, only track renewable generation.

Table 1: Power Content Tracking Systems

System	Generation Tracked
Electric Reliability Council of Texas	Renewable Generation
Michigan Renewable Energy Tracking System	Renewable Generation
Midwest Renewable Energy Tracking System	Renewable Generation
North Carolina Renewable Energy Tracking System	Renewable Generation
New England Power Pool Generation Information System	All Generation
Nevada Tracks Renewable Energy	Renewable Generation
New York Generation Attribute Tracking System	All Generation
PJM's EIS Generation Attribute Tracking System	Renewable Generation
Western Renewable Energy Generation Information System	Renewable Generation

21 NYSERDA is a public benefit corporation that promotes energy efficiency and renewable energy sources through research and development and strategic partnerships.

Figure 6: Renewable Energy Certificate Tracking Systems in North America



Source: National Renewable Energy Laboratory[22]

California Can Improve Its Reporting Practices

Achieving California's ambitious decarbonization goals will require designing an emissions accounting framework that incorporates more accurate power source disclosure (e.g., reducing unspecified power as much as possible) and that breaks down usage by hour.[23] These objectives are put forth, respectively, by AB 1110 and AB 79. This section assesses the technological feasibility of developing an accounting methodology that would provide information that is both more complete and more reliable.

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CAISO's Wholesale Markets

In the CAISO OASIS database of spot market bids, each market participant is represented by a resource identification (ID) number (so that only CAISO knows the identity of each of the participants).[24] All bids in CAISO spot markets are either self-scheduled bids or economic bids. A self-scheduled bid may represent an LSE that is scheduling transmission for power previously purchased through a bilateral power purchase agreement. A self-scheduled bid also may represent, for example, a nuclear power plant that can't ramp power down on the time schedule the bid represents and so must generate regardless of the market price. In addition to generator and load bids from within its territory, CAISO also receives and clears import and export bids at its interties with other balancing authorities.

22 https://www.nrel.gov/docs/fy15osti/64558.pdf.

23 Rather than publishing discreet numbers for each hour of the day, it may be sufficient to provide average annual figures for each hour of the day. Data would be even more informative if presented as hourly averages by season.

24 A Closer Look at Demand Bids in California ISO Energy Market, IEEE XPlore Document.

The CAISO should therefore have data about the following categories of power purchased and served in California.

- *Power purchased by LSEs in the form of long-term bilateral contracts between the LSE and the generator, where both are inside CAISO.* Although, the CAISO does not oversee these contracts, it should have a record of any portion of this power that is served to customers, as the LSE needs to purchase transmission capacity by submitting a self-scheduling bid into the day-ahead market (DAM).

- *Power generated in California and purchased in the day-ahead or real-time markets operated by CAISO.*

- *Power generated outside of CAISO and purchased in the day-ahead or real-time markets operated by CAISO.* This is designated as imported power and not automatically broken down by generating unit.

- *Power generated for ancillary services within CAISO.* This is a small portion of the total load served in the California, so it can likely be ignored in the power source disclosure reporting. However, any power generated for ancillary services is currently included in total system electric generation reporting.

To improve accountability, data on the following sources of power purchased and served in California would need to be provided from sources other than CAISO.

- *Power generated, purchased and served in California balancing authorities that are not a part of the CAISO market (Los Angeles Department of Water and Power, Imperial Irrigation District and the Bonneville Power Administration).*

- *Behind-the-meter generation, such as rooftop solar PV.*

On the supply side, generators submit bids through marketing entities and on the demand side, LSEs submit bids. The market clearing algorithm then starts with the lowest cost resource to serve demand and moves up in price until all demand is fulfilled. The price of the last required unit of generation sets the market clearing price.[25] Then, all LSEs with accepted demand bids pay the market clearing price for energy and an additional variable cost depending on their location, which reflects the variation in cost to deliver energy at different nodes on the grid. Together these two components determine the final price, which is termed the locational marginal price.

The structure of the market means that the CAISO does not ascribe a MWh of energy purchased to an individual supplier because all demand bids are cleared in concert. This "system power" or "market power" is often equated with unspecified power. However, most of the load served in California is procured through long-term bilateral contracts. When an LSE signs a long-term bilateral contract with a generator or power provider, the scheduling coordinator for the LSE still must bid the supply into the day-ahead market as a self-scheduled bid.

Finally, it is important to note that the interplay between the day-ahead and real-time markets can lead to a greater amount of unspecified power. For example, an LSE could buy from a specific source as part of a power purchase

25 The algorithm also considers other factors, such as existing transmission rights, line congestion, etc.

agreement, sell that power in the day-ahead market and then buy back the equivalent amount of power in the real-time market, and then report that generation as unspecified power.

Recommendations

How can policymakers and stakeholders improve the Power Content Label reporting process? Following are some key ideas.

Learn from the Energy Imbalance Market

There are ways to get closer to understanding what is really happening, even in the organized wholesale markets. For example, consider the CAISO Energy Imbalance Market (EIM). It is a real-time, bulk power market that uses an automated system to provide least-cost power resources to meet short-term supply imbalances. Primarily, this market helps respond to fluctuations in supply that occur with reliance on intermittent solar and wind. Its footprint is broader than that of the CAISO, which creates the challenge of tracking the origin of resources imported from outside of the CAISO control area.

To ensure that the market reflects California's climate policy, the CAISO imposes a carbon adder on fossil-fueled imports. Because many of those imports are designated as coming from "system resources" rather than being linked to specific generating units, the CAISO needs to make some assumptions about their carbon content. It does this by undertaking a two-step process. First, the CAISO must determine what generating resources would be running in a particular control area if it were not meeting demand in California. Then, the CAISO adds back the California-related demand to see what units would ramp up or down to serve CAISO's California market. The CAISO can then make a reasonable assumption about the carbon content of the imported power.

Because many of those imports are designated as coming from "system resources" rather than being linked to specific generating units, the CAISO needs to make some assumptions about their carbon content.

To make this assessment requires modeling the generating resources in a participating control area – a relatively expensive process, the cost of which participants in the lucrative EIM have been willing to undertake to be able to participate in that market.

If this kind of approach can be used in the EIM, it could be used in the day-ahead market as well. As in the real-time market, control areas that want to participate in the day-ahead market could be required to submit models of their generating resources. It is a matter of the CAISO instituting such a rule and the participating balancing authorities being able to rationalize the expense. For day-ahead imports from those balancing authorities that have already submitted generation models, the question is why the CAISO cannot use the EIM modeling data to provide better information about content.

The starting point would be for CAISO to determine what it would take, in terms of time and expense, to employ the EIM-style content analysis across all its markets.

Rely on E-tags

Federal regulators require that every power transaction include an e-tag – an electronic record of the source and delivery point for all power sales. When a load-serving entity purchases power from a specific generator, the e-tag makes it possible to understand the content of the delivered power. The challenge comes when the load-serving entity makes a purchase in a day-ahead or real-time market that involves the movement of unspecified power from one control area to another. In this case, the e-tag usually refers to the source as being "system power" from a particular control area.

The CAISO rules could allow the buyer to require that the e-tag for purchased power link that purchase with a specific source.

It does not have to work this way. The CAISO rules could allow the buyer to require that the e-tag for purchased power link that purchase with a specific source. This would be a largely symbolic act unless all the power being generated in the control area were associated with specific purchasers. The rules could require this, as well, for generators in the control area to participate in the CAISO markets.

Pursue the Promise of Blockchain Technology

The digital revolution in electric power service is well underway, with the wide-spread adoption of smart meters[26] and the introduction of automated control technology. In a new report, the International Energy Agency talks about the many ways in which the increased collection and processing of data can lead to improved efficiency, lower costs, more successful integration of intermittent renewables, better demand response, greater accommodation of electric vehicle smart charging and more successful incorporation of distributed generation resources.[27] Blockchain technology would play a role in achieving these benefits.

If blockchain technology can help improve the functioning of the grid as well as offer environmental and economic benefits, it also holds promise as a means for improving the accountability of utilities and other load-serving entities for their power procurement choices.

The International Energy Agency describes blockchain technology as follows.

> Blockchain – also called distributed ledger technology – first drew attention ten years ago as the basis for the cryptocurrency Bitcoin. Blockchain is a decentralized data structure in which a digital record of events (such as a transaction, or the generation of a unit of solar power) is collected and linked by cryptography into a time-stamped "block" together with other events. This block is then stored collectively as a "chain" on distributed computers. Any participant to a blockchain can read it or add new data.
>
> As no single computer system that could fail or be compromised is relied upon, data written to the blockchain is very secure against hacking. Because blockchains are transparent and trustworthy, they

26 "Nearly half of all U.S. electricity customers have smart meters," U.S. Energy Information Administration Annual Electric Power Industry Report, as cited at https://www.eia.gov/todayinenergy/detail.php?id=34012&src=email#.

27 Digitalization of Energy, International Energy Agency (2017), http://www.iea.org/publications/freepublications/publication/DigitalizationandEnergy3.pdf.

> facilitate direct exchanges of value between parties, peer to peer, without the need for a third-party intermediary institution or service provider. In principle, these peer-to-peer transactions can be faster and cheaper than transfers sent through an intermediary (such as an energy exchange). Blockchain transactions can also be automated using "smart contracts" that instruct machines to sell or buy among themselves: self-initiating and self-verifying according to pre-determined conditions and preferences, and transferring funds.
>
> Both start-up companies and utilities see potential for blockchain to help solve key energy sector challenges, including co-ordination between increasing numbers of heterogeneous devices, owners and operators in smart grids, and the need for low-friction, automated trading to enable flexibility. Projects testing uses for blockchain in the energy sector increased rapidly in 2015-16. Many focus on customer markets and enabling micro-trading among solar power prosumers.
>
> LO3 Energy in New York is using blockchain and a microgrid to enable a Brooklyn community to buy and sell locally generated renewable electricity peer to peer within a small neighborhood. German start-up StromDAO uses blockchain to create a "virtual power plant" where participants can self-supply by investing in off-site renewable capacity and reselling this production in a spot market.[28]

Significantly, the International Energy Agency also said the following.

> This is not all that blockchain could be applied to. Other uses are being tested throughout the energy chain. Peer-to-peer trading and settlement in wholesale power and natural gas markets is being trialed in Europe by Enerchain, backed by companies Enel, Iberdrola, RWE, Total, and Vattenfall (enerchain.ponton.de). Start-up Grid Singularity is using blockchain to collect energy generation and grid equipment performance data (gridsingularity.com). Volt Markets in the United States uses blockchain to track Renewable Energy Certificates (RECs) (voltmarkets.com/blockchain). Millions of solar facilities have joined a project to post live solar data to blockchain for use by scientists and researchers at electricchain.org. In 2014, BAS Nederland was the first energy company in the world to accept Bitcoin for bill payment, since followed by companies in Germany (Enercity), Belgium (Elegant) and Japan (Marubeni).[29]

While the promise of blockchain is being offered as a cure for just about everything, its rise as a grid tool appears inevitable. From the outset, blockchain systems could incorporate the ability to track all wholesale transactions and their provenance. This information could be aggregated to provide a significantly more accurate picture of the nature of the power being procured and its environmental consequences. There are ongoing efforts to design a blockchain system capable of performing these functions.

While the promise of blockchain is being offered as a cure for just about everything, its rise as a grid tool appears inevitable.

Clearly, blockchain holds the promise of producing more fine-grained, verifiable records of power transactions. At a minimum, the existence of such

28 Ibid., pp. 97-98.
29 Ibid., p. 98.

a system would enable system operators and regulators to develop a more accurate picture of the resources in a control area's "system mix" at any time. It also would enable those parties to identify the marginal resources that would not be operating but for the load serving California customers. Arguably, it is those marginal resources that should be identified as the sources of power reported on the Power Content Label.

Policymakers can focus now on the implications and benefits of incorporating a blockchain information system as they strive to make utilities and other load-serving entities more accountable for the consequences of their power purchase decisions. Regulators and grid operators could develop or require the use of blockchain for this purpose.

Policymakers can focus now on the implications and benefits of incorporating a blockchain information system as they strive to make utilities and other load-serving entities more accountable for the consequences of their power purchase decisions.

Think of the Power Content Label When Considering Regionalization

The CAISO currently operates all its markets, except for EIM, solely in California. For some time now, California's governor and other key public officials have been pursuing expansion of the CAISO and its control area to cover a broader region throughout the Western states. While this is a controversial proposal that raises difficult questions about governance of the ISO and the scope of state versus federal jurisdiction, the existence of a regional grid operator might improve the accuracy of Power Content Labels. That is because the grid operator can track the origins of electricity generated within its service area. For power in a regional wholesale market that otherwise would be designated as coming from unspecified sources, an ISO would be able to determine the system mix more accurately at any given time. This would enable retailers and regulators to have a more realistic understanding of the impact of buying system power.

Expand the Western Renewable Energy Information System

Accurate hourly emissions calculations for unspecified power will not be possible without a generation attribute tracking system that tracks all sources of generation (not just renewables). Such a tracking system would likely involve an expansion of WREGIS – the regional entity that records and verifies renewable energy credits. Ideally, this system would be developed in concert with changes to CAISO's bidding system that would allow scheduling coordinators to tag self-scheduled load associated with long-term contracts. This would automatically populate the expanded generation attribute tracking system with claimed load and allow for a more efficient calculation GHG emissions.

Strive for Consistency and Accuracy in Content Reporting

As discussed above, the Energy Commission maintains two different content reports: total system electric generation and the Power Content Label. The two reports do not produce identical results. The Energy Commission could perform a detailed comparison of the two, prior to publication. If there are significant discrepancies in the way unspecified power is quantified in the two reports, this could serve as a red flag inviting further analysis. At a minimum, significant differences could be clearly explained at the time of publication. In addition, the state could regularly audit the utilities' data aggregation and reporting practice to promote accuracy.

Always Use Marginal Resource Information

Any emissions calculation of unspecified power could use marginal power sources and not a general system power mix as its input. This could encourage LSEs to favor specified load and more accurately link the casual load with the source generation that must be added to serve that load.

One way to think of the challenge of keeping retailers accountable for their power choices is to see it as an agency problem. No one would contest the assertion that California retailers should be responsible for the climate implications and other impacts of their power choices. They should not be able to escape full responsibility for those choices by making purchases that cannot be tracked. Utilities and other retailers could be enlisted to support efforts to improve reporting by taking such steps as the following.

- Requiring utilities and others to sign only power purchase agreements that provide for ongoing full disclosure of fuel source and greenhouse gas content.
- Assuming the worst: unless LSEs can prove otherwise, assume that all unspecified power is coal-fired power. The burden should be on the LSE to report its generating sources accurately and fully.

No one would contest the assertion that California retailers should be responsible for the climate implications and other impacts of their power choices.

Although key legislators have identified the need to improve reporting and have taken important steps in the right direction, there is still ground to cover before California's reporting processes will be all that they need to be.

Make Retailers Accountable for All Self-Scheduled Power

Under California's procurement rules, utilities are required to limit their purchases from organized day-ahead or hour-ahead markets to no more than 5 percent of their load.[30] They are required to secure sufficient long-term commitments to meet the remaining load. Nonetheless, on average, California utilities report 14 percent of their power as coming from unspecified sources. This suggests that the utilities are treating almost 10 percent of the power they deliver to their customers as unspecified, even though it is derived from known or knowable sources. The California Energy Commission and the California Public Utilities Commission can clarify these numbers and require the utilities to account for the origins of all the power that they schedule onto the grid.

30 California Public Utilities Commission AB 57, AB 380 and SB 1078 Procurement Policy Manual, (Prepared by Energy Division June 2010), Rule G.1(c), p. 4-5. Document found at http://docs.cpuc.ca.gov/efile/rulings/118826.pdf.

Conclusion

Improving the reporting process for the fuel content of delivered power is challenging for several reasons. There are thousands of relevant data points and dozens of supply-side market participants. Most, if not all these participants, lack the motivation to improve the reporting process because it may require additional work, add some expense to power transactions and work against the interests of both power marketers who want to sell dirty power and load-serving entities that want to buy it.

Nonetheless, power customers deserve to know what they are buying whether the product is electricity or food. Would consumers want to buy a food product if the label stated that 14 percent of the content of the package was unspecified? Although customers are not ingesting electric power, they may be inhaling the particulates that are released during its generation or drinking the water affected by its use. Further, customers face the climatological consequences resulting from the release of air pollution emanating from some types of power plants.

The fuel choices made by load-serving entities have consequences. Those companies should not be able to deflect responsibility for such consequences by claiming that they cannot know what emissions they are enabling. Fortunately, we can get closer to the truth about fuel choices. It requires action on the part of retailer providers, power marketers and the operators of organized markets. In addition, it requires resolve and tenacity on the part of regulators. As the role of electricity in reducing greenhouse gas emissions becomes greater, the ability to fully understand the consequences of power choices and to hold retailers accountable becomes all the more critical.

Appendix A – Calculation of Total System Electric Generation

1. Total power generated within California (and at out-of-state power plants that are directly connected to a California balancing authority) is accounted for by totaling generation that is reported by each power plant greater than 1 MW through CEC–1304. In 2015, this made up 66 percent of load served in California.

2. The determination of imports is based on balancing authority reports of imports and exports by the balancing authorities that exchange energy with other non-California balancing authorities. Currently, this includes LADWP, CAISO, IID and BANC. The net import figure is based on total imports less exports during a calendar year.

3. Any imported power than can be accounted for from the utilities' reporting of specified power is allocated to its fuel type based on the power plant technology and the location of the power plant.

4. Any remaining imported power that has not been claimed by LSEs reporting of an audit trail through the Power Source Disclosure (PSD) program is reported as "unspecified power."

5. REC-only transactions are not included in the determination of total system electric generation.

Calculation of Power Content Labels

Information is collected by the Energy Commission from LSEs using the PSD Annual Report Forms workbook.

1. Retail suppliers are required to complete Schedules 1 and 2
   a. Schedule 1 collects the following information for each purchase.
      i. generation facility name
      ii. unit
      iii. fuel type
      iv. generation facility location
      v. WREGIS GU IS
      vi. EIA ID
      vii. FERC QF ID
      viii. gross MWh procured
      ix. MWh resold or self-consumed
      x. net MWh Procured
   b. Schedule 1 includes information about both "Specified" and "Unspecified" purchases.
   c. If a purchase was for unbundled RECs only, that is indicated in parentheses after the facility name in Schedule 1.
   d. If a purchase was for unbundled energy without its previously associate REC, that is not distinguished from the general category of "Unspecified" purchase in Schedule 1.
   e. If the purchase was from a power pool or wholesaler, the pool or wholesaler should be identified under facility name in Schedule 1.

f. Schedule 2 is a summary of the information reported in Schedule 1. The information reported in Schedule 1 is also normalized as a percentage of total retail sales.

Template Provided in Schedule 2 of the PSD Annual reporting working

SCHEDULE 2: ANNUAL POWER CONTENT LABEL CALCULATION
Applicable to: Load Serving Entities

INSTRUCTIONS: Total specific purchases (by fuel type) and enter these numbers in the first column. Null power purchases should be included with Unspecified Power. REC only purchases should be included as part of the fuel type they represent. The remainder of this schedule will be automatically populated with net generic purchase and total retail sales information from Schedule 1. Any difference between total net purchases and total retail sales will be applied pro-rata to each non-renewable fuel type. The pro-rata calculations will then be divided by total retail sales to calculate fuel mix percentages.

	Net Purchases (MWh)	Percent of Total Retail Sales (MWh)
Specific Purchases		
Renewable	-	#DIV/0!
Biomass & Biowaste		#DIV/0!
Geothermal		#DIV/0!
Eligible hydroelectric		#DIV/0!
Solar		#DIV/0!
Wind		#DIV/0!
Coal		#DIV/0!
Large hydroelectric		#DIV/0!
Natural Gas		#DIV/0!
Nuclear		#DIV/0!
Other		#DIV/0!
Total Specific Purchases	-	**#DIV/0!**
Unspecified Power (MWh)		**#DIV/0!**
Total	-	
Total Retail Sales (MWh)		

2. Schedule 3 is for entities that operate power pools. Data is supplied across the following fields for each generator from which the power pool purchased power.
   a. Facility name
   b. Fuel type
   c. EIA ID
   d. WREGIS GU ID
   e. QF ID
   f. MWh sold into pool

3. Schedule 4 should be filled out for any entity that provides information on Schedule 3. This form details power that was sold out of a given power pool. The name of purchaser (but not any other identification) along with the MWh purchased should be indicated on this form. Schedule 4 also asks the power pool operator to break down specific purchases from their pool by fuel type.

Name of Purchaser		
	MWh Purchased	**MWh Purchased**
Specific Purchases		
Renewable		
Biomass & Biowaste		
Geothermal		
Eligible hydroelectric		
Solar electric		
Wind		
Coal		
Large hydroelectric		
Natural Gas		
Nuclear		
Other		
Unspecified Power Purchases		
Total Purchases from Pool	-	-

Discrepancies in Reporting

The following tables compare the results of calculating unspecified power sales for select California LSEs and the statewide unspecified power reported in the Total System Electric Generation Table.

Entity	Retail Sales 2015 (MWh)	Proportion Unspecified	Unspecified Power 2015 (MWh)
Bear Valley Electric Service	132,793	0.77	102,251
Los Angeles Department of Water & Power	23,336,197	0.04	933,448
PacifiCorp	738,802	0.1268	93,680
Pacific Gas & Electric Co	72,481,825	0.17	12,321,910
Sacramento Municipal Util.	1,0473,799	0.23	2,408,974
San Diego Gas & Electric Co	16,266,919	0.11	1,789,361
Southern California Edison	75,438,205	0.41	30,929,664
Total	**230,153,965**		**48,579,288**

The unspecified sales reported above were calculated from 2015 retail sales data from EIA[31] and proportion of unspecified power reported in the 2015 Power Content Labels[32] to determine the aggregate unspecified power reported by all load entities in California.

2015 Total System Electric Generation in Gigiawatt Hours

Fuel Type	California In-State Generation (GWh)	Percent of California In-State Generation	Northwest Imports (GWh)	Southwest Imports (GWh)	California Energy Mix (GWh)	California Energy Mix
Coal	538	0.30%	294	16,903	17,735	6.00%
Large Hydro	11,569	5.90%	2,235	2,144	15,948	5.40%
Natural Gas	117,490	59.90%	49	12,211	129,750	44.00%
Nuclear	18,525	9.40%	0	8,726	27,251	9.20%
Oil	54	0.00%	0	0	54	0.00%
Other	14	0.00%	0	0	14	0.00%
Renewables	48,005	24.50%	12,321	4,455	64,781	21.90%
Biomass	6,362	3.20%	1,143	42	7,546	2.60%
Geothermal	11,994	6.10%	132	757	12,883	4.40%
Small Hydro	2,423	1.20%	191	2	2,616	0.90%
Solar	15,046	7.70%	0	2,583	17,629	6.00%
Wind	12,180	6.20%	10,855	1,072	24,107	8.20%
Unspecified Sources of Energy	N/A	N/A	20,901	18,972	39,873	13.50%
Total	**196,195**	**100.00%**	**35,800**	**63,410**	**295,405**	**100.0%**

Total system electric generation in California as reported by the California Energy Commission.[33] Total unspecified power: 39,873,000.

31 https://www.eia.gov/electricity/sales_revenue_price/pdf/table10.pdf.
32 http://www.energy.ca.gov/pcl/labels/.
33 http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html.

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visit **www.energycenter.org/policy**
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Knowing Your Power: Improving the Reporting of Electric Power Fuel Content in California,
Center for Sustainable Energy, San Diego, CA

Offices

San Diego (Headquarters)

9325 Sky Park Court, Suite 100
San Diego, CA 92123
858-244-1177

Los Angeles

617 West 7th Street, Suite 305
Los Angeles, CA 90017
213-481-6115

Oakland

1111 Broadway, 4th Floor
Oakland, CA 94607
415-692-1500

Boston

50 Milk Street, 16th Floor
Boston, MA 02109
857-243-2021

EnergyCenter.org