

**California and Western Energy Agencies Lecture Series:
Lecture #1: Introduction, Basic Facts, and Agency Overview
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Stanford University
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Slide 1:

Hello. My name is Dian Grueneich.

I am a Precourt Energy Scholar with the Precourt Institute for Energy and an Affiliated Scholar with the Bill Lane Center for the American West, both at Stanford University.

I was a California policymaker for six years, as a Commissioner with the California Public Utilities Commission. I have been involved with California and Western energy issues and policymaking for over 40 years.

Slide 2:

My talk covers five topics:

1. Overview of Electricity and Natural Gas Systems
2. Concepts and Facts about California and Western Energy
3. Key California Energy and Climate Agencies
4. Key Western Energy Organizations and
5. Summary Observations.

Three of the organizations I discuss in this lecture are covered in separate lectures:

- the California Independent System Operator (or CAISO),
- the Western Interstate Energy Board (WIEB), and
- the Western Electric Coordinating Council (WECC).

Slide 3:

Let me start with an Overview of Electricity and Natural Gas Systems.

Slide 4:

There are three major features of the typical U.S. electricity system: Generation, Transmission, and Distribution.

Starting on the left of this slide is generation – often called bulk power or utility scale generation – basically large power plants. While traditionally these plants were coal-fired, nuclear and hydroelectric, many are now natural gas-fired, wind, and solar. The plants are owned by either utilities or, as is the case in much of California, by third parties known as Independent Power Producers, or IPPs.

The second major part of the electricity system is the transmission system. This system consists of high-voltage lines carrying power over long distances from a generating site to an electric substation. Transmission lines in the U.S. are mostly owned by utilities but recent efforts have focused on supporting third-party ownership. The lines themselves are operated by either the owners or, in many regions of the U.S., by third parties known as Independent System Operators (ISOs) or Regional Transmission Operators (RTOs).

The distribution system is the third part. These lines are the final stage in delivery of electric power and carry electricity from the transmission system to individual, end use facilities and buildings, such as homes, factories, and office buildings. These lines are owned and operated by the local utility.

Depending upon the state regulatory system, the power that is delivered can be owned either by the utility who sells it to an end user

or by a third party, known as a retail service provider, who sells it to end users.

At the individual building level are meters, which measure the energy usage or load in the building. In recent years we have seen the building of distributed energy resources, most of which are “behind the meter”, i.e., physically located on the individual’s property.

Slide 5:

This slide shows the basic U.S. natural gas system.

The three physical components are: Extraction and Processing, Transmission and Storage Systems, and the Distribution System.

For the first component, the key players, who withdraw gas from wells, are large oil and gas companies and smaller independent production companies. From the wellhead, natural gas is sent to processing plants.

The natural gas is then transported through pipelines in the second part of the system to underground storage fields or sent directly to distribution pipelines. At the distribution level, the gas is then delivered directly into commercial and residential buildings or to large end users such as factories.

In many states, including California, non-residential customers can buy gas directly from a marketer who purchases gas from producers or processors and arranges for delivery to the customer’s local gas distribution company (LDC).

Slide 6:

I will now turn to my second topic – Key Concepts and Facts about California and Western Energy. The focus of this discussion is on the electricity system.

Slide 7:

In this section I cover four areas:

- 1) California Electricity Suppliers,
- 2) Balancing Authorities (BAs),
- 3) the California Electricity System, and
- 4) California Greenhouse Gas (GHG) emissions.

Slide 8:

Let me start with who sells electricity in California.

California has five categories of retail sellers, totaling 88 different companies and organizations as of early 2019. In California, most of the electricity has traditionally been sold by the local utility, which includes investor-owned utilities (IOUs), publicly-owned utilities (POUs), rural cooperatives, and 3 Native American utilities.

But, in the 1980s, California passed a law allowing another category of retail seller into its IOU markets. These are called Electric Service Providers or ESPs. ESPs include private companies selling electricity to non-residential customers (often called direct access in California) and more recently, Community Choice Aggregators or CCAs.

To recap, retail electricity sellers are entities that sell electricity directly at the retail level to individuals and businesses. Retail sellers regulated at the state level by the California Public Utilities Commission (CPUC) are called Load Serving Entities or LSEs and they provide about 80% of the electricity sold in California.

Of note, in addition to California, four other Western states - Arizona, Nevada, Montana, and Oregon -- also allow sales of electricity by non-utilities directly to customers, typically to large businesses only.

Slide 9:

I've been using the term utilities so let me take a moment to clarify what is a utility.

Utilities are key players in the energy system, particularly in California and the West.

First – what does a utility do? Utilities have a wide range of roles, which are changing and increasing with the advent of clean energy. A utility owns distribution lines – gas and/or electric. As I described before, it may or may not own transmission lines, pipelines, and/or powerplants. And, via its delivery role, it provides services – keeping lights on, perhaps providing electric vehicle charging stations, etc. And, the geographic area in which a utility operates is called its service area.

Second - who owns a utility? Some utilities, such as Southern California Edison, are owned by their investors and their stocks are publicly traded. A second type of utility is run by local government; these utilities are called publicly owned utilities or POUs; examples are the Sacramento Municipal Utility District and the City of Palo Alto Utilities. The third model is a cooperative utility, a not-for-profit entity that is owned and controlled by its members. Coops typically operate in rural areas.

The third area that is important is who regulates the utility. In the U.S., energy has a very complex web of regulation. Energy is very different from the internet, for example, which has minimal regulation at any level. In contrast, in energy there is regulation at every level - federal, state, and local. Who regulates a utility depends on what the utility does and who owns it.

Generally speaking, federal regulation occurs in the bulk system at wholesale levels (e.g., generation and transmission) or when transactions cross state lines. The major federal regulator is the Federal Energy Regulatory Commission (FERC). IOUs are generally highly regulated at the state level by their public utilities' commission. POU are regulated at the local level, generally by an elected board.

Finally, I want to mention that there are a host of other very important players in the energy landscape, such as competitive retail sellers, CCAs, ISOs/RTOs/PPs. In this lecture I mention all of them but remember they are not utilities.

Slide 10:

Here is a map of California's five largest electric utilities, each with its own service area.

The top three IOUs are: Southern California Edison or SCE, which is owned by a parent company called Edison International; San Diego Gas & Electric Company (SDG&E) whose parent company is Sempra, and Pacific Gas and Electric Company (PG&E), which filed for bankruptcy in January 2019 and whose structure may change as a result.

California has over 40 publicly-owned or municipal utilities, many of them small. But there are two very large POUs. Los Angeles Department of Water and Power (LADWP) is the largest municipal utility in the country. The second largest is the Sacramento Municipal Utility District (SMUD).

Also of note are the gas utilities in California. SoCalGas is the nation's largest natural gas distribution utility, delivering gas to almost 22 million accounts. Its service area is approximately the same as SCE and LADWP combined. SDG&E and PG&E both have gas utilities within their combined utility companies.

Slide 11:

Another key entity in California selling electricity directly to end users is the community choice aggregator or CCA, which are increasingly important players in California. CCAs only sell electricity; they do not provide gas service.

Community choice aggregation programs allow local governments to procure power on behalf of their residents, businesses, and municipal accounts from alternative suppliers while still receiving transmission and distribution service from their existing utility providers. CCAs are currently authorized in seven states, according to the U.S. EPA, including California.

CCAs have been allowed under state law because CCAs may be able to provide power less expensively than the local utility and it allows more local control over electricity supplies. CCAs typically offer several options for their customers in the mix of electricity sources, including plans with high percentages of renewable energy, typically provided at a price premium.

Slide 12:

This map shows the spread of CCAs in California.

The green shows CCAs serving electric customers as of January 2019 and you can see CCAs now operate in almost all of the Northern California coastal counties and are spreading rapidly to Southern California as well.

The California Public Utilities Commission estimates that by 2025, up to 85% of the state's IOU retail load could be served by CCAs and the other

type of non-utility provider that I mentioned earlier, direct access providers.

Slide 13:

I now want to move on to another important concept – that of Balancing Authorities. You can learn more about this topic in the lectures provided by the CAISO and by WECC.

Briefly, a Balancing Authority balances generation and load in order to maintain the electric frequency of the grid. In the West, we have 38 balancing authorities, many of which are small public utilities keeping loads and supply balanced for the customers in their service areas.

The CAISO was formed in part to provide greater efficiencies by creating a single large BA for the three large CA IOUs – PG&E, SDG&E, and SCE. The resulting BA is the largest in the West, covering about 36% of the load.

Slide 14:

This slide shows on the left in light orange the territory of the CAISO – e.g., its balancing authority scope. It also shows the nine other BAs operating in California. As you can see, there are still quite a number of BAs, in addition to the CAISO, in California.

The map on the right shows the transmission lines that the CAISO controls, both within California and those that extend to neighboring states. The CAISO is able to control frequencies over these lines through its extremely sophisticated operations in Folsom, CA.

Slide 15:

A final mention on the CAISO.

The Western Energy Imbalance Market or EIM is an extension of the ISO's real-time market to any balancing authority in western North

America. The EIM automatically selects low-cost resources to meet customer demand, without requiring other utilities or entities to give up their BA oversight.

In the figure on the right, the dark orange shows the EIM participants as of early 2019 and the blue balancing areas are future participants.

Again, you can learn more about the EIM in the separate CAISO lecture.

Slide 16:

Let me now turn to a new topic -- an overview of the types of electricity supplies for California.

This chart compares electricity sources for California in 2012 and 2017.

First, note that California imports a significant amount of the electricity it uses, about 30%. Traditionally, much of this was from out-of-state coal plants but now much is from solar and wind, because those resources are of very high quality in other states and thus can be less expensive than building similar facilities in California.

So, let's take a closer look:

Coal was a small source in California by 2012 (8%) and decreased to 4% five years later. Within a few years, it will probably be under 1%.

Nuclear has stayed the same, but PG&E is closing California's last nuclear power plant, Diablo Canyon, in 2024-2025 so that number will be 0% within a few years in all likelihood.

Large hydroelectric generation provided an increased share in 2017 compared to 2012 but that change was due in large part to the lower availability of hydroelectricity in 2012 due to drought.

Renewables (which in California does not include large hydroelectric production) almost doubled between 2012 and 2017 and by 2018 reached over 30%.

Natural gas powerplants increased significantly, from almost 10% in 2012 to 34% in 2017. A source of continuing debate in California is how much of the additional supply needed by phaseout of nuclear and coal will come from natural gas versus solely from renewables and hydroelectric generation.

The final row is for unspecified sources. This category reflects that it is often impossible to determine the source of electrons that come into California since many of the transactions occur under non-public contracts and electricity flows based on physical factors, regardless of contractual agreements.

Slide 17:

Now, let's take a look at electricity supplies for California vs. the entire United States.

These numbers are from the U.S. Energy Information Agency (EIA). They are for in-state electricity generation. The prior slide examined California electricity consumption, which as I noted, includes about 30% of supply imported from other states. Thus, this slide is showing information for the remaining 70%, the in-state generation.

Also, the EIA definition of renewables includes large hydroelectricity generation whereas California does not count such generation in its definition of renewables.

The item that stands out the most is coal use in the United States versus California. Coal provided about 50% of electricity in the U.S., through

2010. It has decreased since then but is still significant. For California coal does not even show since California no longer uses any significant amount of coal for in-state electricity production.

Second, let's look at renewables, the green slices. For California, they have been steadily increasing. They have also increased for the U.S. but you can see the percentage of renewables in the U.S. overall is still small.

Finally, blue is natural gas. You can see the significant increase in the production of natural gas electricity, both in the US and in California.

If we take a look at these numbers through the lens of carbon emissions, you can see the challenge ahead, not just for California but for the country as a whole.

Slide 18:

Finally, let's take a look at California's Greenhouse Gas (GHG) emissions.

California law requires the California Air Resources Board (CARB) to track GHG emissions and provide an annual emission inventory. These CARB charts are based on the latest emission inventory published as of January 2019 and are for the year 2016.

The left pie chart shows the types of California GHG emissions. While carbon dioxide (CO₂) is the largest source (83%), the other pollutants are still significant, especially short-lived climate pollutants like methane, which accounted for 9% of GHG emissions in California in 2016. And, these charts do not include emissions from what in California are called natural and working lands, which include carbon in forests, grasses, and scrublands. As the California wildfires have shown, if this natural vegetation burns, huge amounts of GHG emissions can be released.

The chart on the right is very important because it shows emissions by economic sector. As can be seen, the transportation sector is the source of over 40% of California GHG emissions; hence, there is a tremendous focus in California on reducing transportation GHG emissions by moving toward Zero Emission Vehicles (ZEVs) such as electric vehicles and hydrogen fuel cell cars, public transit, and building housing closer to where people live or work.

The second largest source is the industrial sector, which includes California's oil and gas refineries, also related to the transportation sector.

In-state electricity production accounted for 10% of emissions and electricity imports counted for another 6%. Both of these wedges are significant but the state's focus on renewables and carbon free sources is reducing these emissions significantly.

Finally, emissions produced in buildings – 7% in homes and apartments and 5% in commercial – is another significant source.

Slide 19:

My third area of focus is on the Key California Energy and Climate Agencies.

Slide 20:

The following slides provide summary information on:

- the key energy and climate agencies in California
- their differing histories,
- their structures,
- their oversight by other agencies,
- their roles,

- their energy responsibilities, and
- common challenges they face.

Slide 21:

Here is the list of the five top California energy agencies:

The California Energy Commission, or CEC.

The California Public Utilities Commission, or CPUC, on which I served as a Commissioner for six years.

The California Independent System Operator, or CAISO.

The California Air Resources Board, or CARB.

The California Department of Water Resources, or DWR.

I want to give two important clarifications.

First, in these slides and lecture, I use the term agencies to include the CAISO. Technically, the CAISO is not a governmental agency; it is a not-for-profit organization set up under California law and, and as I describe later, regulated at the federal level by the Federal Energy Regulatory Commission, or FERC. However, for purposes here, I refer to it as an agency.

Second, two of these organizations – the CEC and the CAISO – are focused entirely on energy. The CPUC is primarily but not entirely focused on energy. But for the other two, CARB and CDWR, their primary missions are non-energy. Air quality for CARB and water for CDWR. However, both water and air quality are areas that are increasingly intertwined with energy, and thus these two agencies are also central in California's energy focus.

Slide 22:

In the following slides I will review, for each of the 5 organizations:

- their history, structures, oversight, roles, and energy responsibilities.

Let me start with history.

Each of the five agencies was created at different times and for different reasons. As a result, the cultures, processes, and even employees within each agency differ significantly, influenced in part by the age of the agency.

But, very interestingly, the authorizing legislation for all five of these agencies was signed by Republican governors after bipartisan legislative support.

Let me start with the oldest, the CPUC. It was set up to regulate the railroad monopolies who controlled the only viable method of long-distance transport and charged fees far above costs. The CPUC was also set up in San Francisco, not Sacramento, where the rest of state government and the legislature were, to decrease the ability of railroad lobbyists to influence the new agency.

And, it was set up by Constitutional Amendment which means that its decisionmakers, while appointed by the Governor and confirmed by the Senate, cannot be removed except for malfeasance. The agency was put into law a year later in 1912 and renamed the CPUC in 1946.

The next oldest agency is the California Department of Water Resources, or DWR, created 45 years later in 1956. More background on DWR's formation is given in a recent book, *The Browns of California*, which recounts that prior to the creation of DWR, more than 52 separate state agencies handled different aspects of water regulation and California had passed over 70 laws creating a myriad of local irrigation districts, water districts, county waterworks districts and the like, totaling over 382 different local water agencies.

DWR was formed to have a single agency with centralized power to plan and manage California's water, thus leading to the genesis of the State Water Project, to provide water for a rapidly growing state.

Eleven years later, in 1967, the California Legislature created the California Air Resources Board, or CARB, to address very serious air pollution. Smog first occurred in Los Angeles in 1943, limiting visibility to three city blocks. It was thought to be a gas attack from a nearby factory but pioneering research discovered the cause – automobile emissions – in the early 1950s, with help from leading academic researchers, including those from Stanford. A fascinating video on the history of CARB can be found on its website <https://ww2.arb.ca.gov/about/history>.

Three years after CARB was established, Congress passed the federal Clean Air Act, which recognized California's prior efforts and authorized California to set its own separate and stricter-than-federal vehicle emissions regulations to address the worst air in the country.

The California Energy Commission or CEC was created in 1974 and has its own unique history, growing out of gasoline shortages and rationing stemming from the 1973 Middle East oil embargo combined with utility predictions back then that 60-70 new nuclear powerplants would be needed along the California coast to accommodate a doubling in electric load every 10 years.

Twenty-four years later, in 1998, the Legislature created the California Independent System Operator, or CAISO, as part of the state restructuring of electricity markets and responding to passage of the federal Energy Policy Act of 1992, which sought to enhance competition in wholesale electricity generation. As I noted previously, although the CAISO was created by California law, it is not a state agency.

Slide 23:

Most California state agencies have their headquarters in Sacramento, though many have smaller offices in Los Angeles, San Francisco, or elsewhere. The CPUC is different, headquartered in San Francisco, because of its historical roots. The CAISO is located just outside of Sacramento, in Folsom, and also has a backup operational system in Lincoln, CA about 30 miles from Folsom.

The leadership of the CEC and CPUC is similar – five Commissioners appointed by the Governor who also designates the Chair for the CEC and the President for the CPUC. All Commissioners must be confirmed by the Senate. Decisions and rules issued by these agencies must be approved by a majority of Commissioners.

CEC Commissioners serve for 5 years; the CPUC term is 6 years. Commissioners may be reappointed and serve multiple terms. And, each of the CEC Commissioners has a designated expertise area, such as science, legal, and economics.

The CAISO is similar with five Board of Governors, appointed by the Governor who also designates the Chair, but they serve 3 year terms.

The Board leadership at CARB is very large – 16 Board members – some of whom are appointed by the Governor, who also designates the Board chair, and some appointed by Legislative leadership.

The CA Dept of Water Resources functions as a more traditional agency with a Director appointed by the Governor and confirmed by the Senate, who has no term but sits at the pleasure of the Governor.

What these structures mean is that the leadership of the CEC, CPUC, and CAISO often continues through changes in the governor, though it is certainly not unusual for changes to occur. Generally, the other

Commissioners continue to serve out terms, even under new Governors. For CARB and CDWR, the head will change unless the new Governor reappoints the existing Chair/Director.

California's new governor, Gavin Newsom, took office in early January 2019. As of February 2019, the heads of all of these agencies, appointed by former Governor Jerry Brown, have remained the same except for the CEC, where the Chair retired in February and the Governor appointed another CEC Commissioner, David Hochschild, as the new Chair.

All of these agencies have a lead Executive Director (or President for the CAISO) who works closely with the agency leadership and all have large staffs, ranging from more than 3500 at CARB to over 1000 at the CEC and CPUC.

Slide 24:

The oversight of these five organizations varies significantly.

Because of its role in wholesale markets and interstate transmission, the CAISO is regulated by a federal agency, the Federal Energy Regulatory Commission (FERC) which approves its tariffs (i.e., charges for services) and market rules. FERC decisions can be challenged in federal court.

In contrast, as I noted earlier, the CPUC is established under the California Constitution so its decisions stand by themselves and have limited judicial review.

Both the CEC and DWR are part of another California state agency, the Natural Resources Agency, which oversees a total of 27 entities.

Likewise, CARB is one of six departments under the California Environmental Protection Agency (CalEPA).

Neither the Resources Agency nor CalEPA sets policy or directs the decisions of the entities they oversee but they do focus efforts on the goals of the current administration, since the heads of the CalEPA and Resource Agency are also cabinet secretaries, working closely with the Governor's office. Decisions of the CEC, CARB, and DWR can be and often are challenged in court.

Slide 25:

The roles of these five organizations are complex and varied.

The CEC is California's primary energy policy and planning agency and also serves as lead on international energy activities, which is very important given California's climate leadership.

The CPUC's primary role is to regulate privately owned utilities in California -- electric power companies, natural gas, water, and telecommunication companies. But it also regulates common carriers such as passenger transportation companies like Lyft and Uber and other public service providers such as community choice aggregators. And it has a lead role on wildfires and safety in terms of the IOUs.

The CAISO's principal role is operating a competitive wholesale electricity market and for managing reliability for its service area, which is about 80% of CA's electric flow.

CARB's role focuses on clean air in California by regulating emissions from vehicles and fuels and other programs. Separately, California has local air districts that set standards for stationary sources like powerplants.

DWR's role is to manage and regulate California water resources. Like CARB, it works within a federal framework; for DWR -- the Clean Water Act and other federal laws and a regional regulatory network, that of water resource control districts which are overseen by a separate state agency, the State Water Resources Control Board.

In sum, one can think of the five agencies' overall roles as:

CEC – energy policy

CPUC – investor-owned utility regulation

CAISO – reliability and markets

CARB – clean air

DWR – water management.

Slide 26:

The day-to-day responsibilities of these five organizations are extremely large in scope and complex. On this slide and the next one, I set forth key energy responsibilities.

The CEC adopts the state's long-range gas and electric forecasts. It also permits thermal powerplants (natural gas) over 50 Mw. One of its most critical roles is setting appliance standards and building codes, leading the world in these areas of energy efficiency. It also tracks statewide compliance with California's renewable goals.

The CPUC has an increasing focus on safety but also in its role as regulating utilities, it sets the rates they can charge and the profits they can make. The rates set by the CPUC fund most of the state's clean energy programs within the service areas of the IOUs - energy efficiency, solar PV and storage rebates, EV and fuel cell charging infrastructure, etc.

It also sets rules for energy utility procurement and the Renewable Portfolio Standards (RPS), and approves power purchase agreements

that are entered into by the IOUs. Another very important responsibility is that of planning and permitting any new proposed IOU transmission lines.

The CAISO ensures that all market players have access to the state's transmission grid under its purview and oversees reliability by centrally dispatching generation and coordinating the movement of wholesale electricity. It also operates a variety of markets, which are explained in the separate CAISO lecture.

While CARB is an air quality agency, the linkages between air, including GHG emission reductions, and energy are increasingly important. One CARB responsibility is preparation of the federally mandated State Implementation Plans or SIPs under the federal Clean Air Act. CARB and the U.S. EPA allow use of emission reductions from renewable energy and energy efficiency to count as SIP credits.

Another intersection with energy is CARB's role as the central agency for implementation of California's climate goals and reductions in GHG emissions. The state's clean energy policies are central to GHG emission reductions.

DWR's major energy focus comes through its role operating the State Water Project (SWP), which is not only the largest state-built water and power system in the U.S. but one of the largest public water and power utilities in the world and the largest single consumer of power in California.

The SWP collects water from rivers in Northern California and redistributes it to urban users in Southern California and the San Francisco Bay Area, as well as for irrigation in California's Central Valley. It includes pumping water over the Tehachapi Mountains in Southern

California, the highest single water lift in the world. It has more than 20 dams and 700 miles of canals, pipelines, and tunnels.

As a utility both selling and buying power, the SWP participates in the CAISO markets, holds power and transmission contracts, and is subject to CARB's emissions reporting and compliance requirements. The State Water Project Power & Risk Office (PARO) in DWR handles many of these energy responsibilities.

Slide 27:

This slide lists more of the many energy responsibilities of CA agencies and it also shows how interrelated are the agency's energy activities among its agencies.

Let me focus on transportation.

As I explained earlier, CARB is the central agency in this area. Its responsibilities for transportation include not only setting emission limits and fuel standards for cars and trucks but also identifying how GHG emissions can be reduced, which it does in a document known as the Climate Change Scoping Plan. It also funds both research and grants for advanced transportation.

But all the other organizations are involved. The CEC has a transportation division that funds research and grants. The CPUC, through its regulation of IOUs, oversees funding of much of the new EV and fuel cell charging infrastructure being built in California as well as new tariffs to encourage EV charging at optimal times for the grid. The CAISO is working closely on understanding both how EV charging patterns will change electricity usage and how it too can develop new markets to incentivize EVs and their charging patterns. DWR is focused on how it can switch its extensive transportation fleet to a cleaner one.

Slide 28:

As you can imagine with the complexity of California's energy system and its size, the state agencies charged with overseeing and managing it have many challenges.

A major challenge is agency coordination, given both the overlap in responsibilities as well as the physical realities that the agencies are not even all located in the same city, much less adjacent to each other. One mechanism that has been used is an informal gathering of the leaders of these key agencies, including the CAISO, with the Governor or his key staff, in what is known as the Principals Group. These discussions allow candid assessment of issues and identification of how to coordinate agency activities. The staffs of the agencies are in regular communication as well. But, coordination remains a constant challenge.

A second challenge in the energy space in particular is understanding innovation – such as new technologies, business models, finance tools. The agencies do not have innovation offices or management staff tasked in these areas. While all of them are sincerely interested in understanding new developments outside of agencies, it is a challenge to learn where there are new opportunities, much less to then develop pilots, demonstration and grant programs, and the like to test new products, services, and approaches.

A third challenge, which is often overlooked and certainly not unique to California government, is evaluation of how state government policies and programs perform. There is fairly good tracking of compliance with specific requirements – such as meeting an RPS goal – but it is rare that an agency has the resources to review programs comprehensively in terms of goals, costs, outcomes, internal resources to administer, and lessons learned. Given that many of California's energy efforts are

groundbreaking and the first of their kind, much more rigorous evaluation is needed.

And finally, there is a continuing challenge of recruitment of state agency employees, especially for new skills and positions. The vast majority of staff at state agencies operate within the state civil service system, which has very precise definitions of positions, and within the constraints of state budgets which allocate precise numbers of positions in agency offices and divisions generally. And, the salaries are rarely competitive with the private sector.

On the other hand, the jobs themselves are generally extremely rewarding and often with significant responsibilities and challenges. And the knowledge and contacts gained can be invaluable if then applied in the private sector.

I worked at two different times in California government, the first at the CEC and the second at the CPUC. Both experiences were unparalleled in terms of personal enjoyment and professional growth. But securing excellent people to work in state government, while critical to the success of California's energy future, is a definite challenge.

Slide 29:

The next part of this lecture moves beyond California to the West and the Key Western Energy Organizations.

We focus on the West for several reasons.

First, as I noted earlier, California imports a significant amount of electricity, around 30% in 2017.

Second, the Western grid, known as the Western Interconnection, is physically connected, and thus decisions and events in one part of the

West impact throughout the region. And, with increasing focus on GHG emission reductions, coordination among regions and states will have more impact than single state actions.

Slide 30:

I will do an overview for the key Western energy organizations:

- who they are,
- the regions in which they operate,
- their differing histories,
- their structures,
- their oversight,
- their roles, and
- their energy responsibilities

Slide 31:

There are three major Western U.S. energy organizations:

Western Interstate Energy Board – WIEB

Western Electricity Coordinating Council – WECC

Western Governors’ Association – WGA

For the two entities most involved in energy, WIEB and WECC, there are separate, detailed lectures, so my review will be brief.

Slide 32:

WIEB, WECC, and WGA have slightly different geographic regions in the Western U.S. that they work in. And, both WIEB and WECC also work in the 3 Western Canadian provinces.

WECC’s regional footprint is specifically that of the Western Interconnection which stretches from Western Canada south to Baja

California in Mexico, reaching eastward over the Rockies to the Great Plains. It is the grid that ties together all electric utilities in the West.

Slide 33:

As with California's energy agencies, the three Western organizations were formed at different times and for different reasons.

The oldest of these organizations is WECC, which started in 1967 as a voluntary organization among 40 electric power systems to coordinate operations and was known then as the Western Systems Coordinating Council. Its name changed to WECC in 2002 when three regional transmission associations merged and in 2007 it received delegated authority from the North American Electric Reliability Corporation (NERC).

Western governors created WIEB in 1970, originally to support cooperation among states on nuclear energy development. But its charter included "related fields" so its focus is broad and covers both electricity and non-electricity energy issues.

The third organization, WGA, is the newest. It was formed in 1984 through the merger of two Governors' organizations to provide leadership on Western issues. And, unlike WIEB and WEEC, which focus only on energy issues, WGA addresses a broad range of issues important to the Western states including, but not solely, energy.

Slide 34:

The three Western energy organizations have both differences and similarities in their structures.

Each organization is overseen by Board members or, for WGA, state Governors. The WIEB Board members are appointed by the Governor of each state or, for Canada, the Premier of each province. For WGA, it is

Governors themselves who serve on the Board. And for WECC there is an independent board, elected by WECC membership.

WIEB and WGA are both located in Denver, CO and in fact in the same office building on the same floor. WECC is in Salt Lake City.

Slide 35:

Now looking at their oversight, both WIEB and WGA are independent organizations.

WECC is independent but has delegated authority from NERC and the Federal Energy Regulatory Commission (FERC) which means that both of those entities have oversight jurisdiction over WECC activities.

Slide 36:

Turning next to roles. The roles these three organizations are different but they all work closely together on energy issues.

WIEB and WGA are both focused on supporting the West through identifying, in the energy area, key issues and then working on cooperative steps to address the issues.

WECC's role is focused, under its directives from the federal level through NERC and FERC, on ensuring reliability in the Western electricity system. WECC is a designated Regional Entity which means that it is responsible for monitoring and ensuring compliance with NERC reliability standards for the Western U.S. and Western Canada.

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The separate lectures by WIEB and WECC provide in-depth information on their energy responsibilities.

But let me provide a brief overview.

Both WIEB and WGA promote energy policies that their governing members have developed through their respective states and, in the case of WIEB, Canadian provinces.

WIEB operates primarily through its committees, of which there are four:

High-Level Radioactive Waste Committee (HLRW), created in 1983, which works to develop a safe transportation program for nuclear waste;

Committee on Regional Electric Power Cooperation (CREPC), created in 1984, which is a joint committee of WIEB and Western utility commissioners, that works to improve the efficiency of the Western bulk electric system and on which I sat when I was a Commissioner at the CA Public Utilities Commission;

Western Interconnection Regional Advisory Body (WIRAB), created in 2006 by FERC pursuant to the Federal Power Act, is a regional advisory board to FERC, NERC, and WECC on bulk electric system reliability matters in the Western Interconnection; and

Western Energy Imbalance Market-Body of State Regulators (EIM-BOSR), a recent creation, is a forum for state utility commissions to learn about markets, including the CAISO's Energy Imbalance Market.

WECC, as I have noted, is focused on ensuring reliability of the Western electricity system. It does so by developing mandatory standards and then monitoring and enforcing compliance. Its responsibilities also include forward looking studies on reliability planning and operation and education and training.

WGA is focused on a broad range of issues, beyond energy. It conducts research and analysis, identifies best practices, and helps educate a wide range of stakeholders. As one example of its work, it publishes and updates an “Energy Vision for the West,” which can be found on the WGA website.

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Let me conclude with some final observations.

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First, California’s energy systems are large and complex, serving a state with the world’s fifth largest economy. There are thousands of different owners and operators of the physical components that make up the state’s natural gas and electricity systems, as well as a myriad of stakeholders with vital interests in energy. But, these systems are interwoven, physically through the electric grid and gas pipelines, through private financial arrangements, as well as through markets and agency oversight.

Second, multiple agencies are responsible for energy in California, not just because of the complexity and size of California’s energy systems but also because of the impacts of energy on the environment.

Third, each of these five organizations was formed at a separate time, to address a problem specific to that era, and as a result, each has its own culture and focus. And, the responsibilities of each vary but also overlap. However, on a very fundamental basis, each one of these agencies, including the CAISO, share a common vision of providing reliable, affordable, and sustainable energy.

And fourth, California’s energy system and issues are part of the larger Western energy system. What happens in the West is critical to California and vice versa. California is connected to the West at many

levels – through the physical system where electrons and molecules flow regardless of legal boundaries, through a myriad of federal and state laws and regulatory systems, through markets and private transactions, through environmental impacts that do not recognize state or local boundaries, and through the flow of people and goods. But the good news is that there is a long history in the West of people and states working together.

Slide 40:

Thank you very much.

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