Transportation Electrification

Market Assessment, Policy Overview, and Utility Guidance Pursuant to Senate Bill 350

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California Public Utilities Commission

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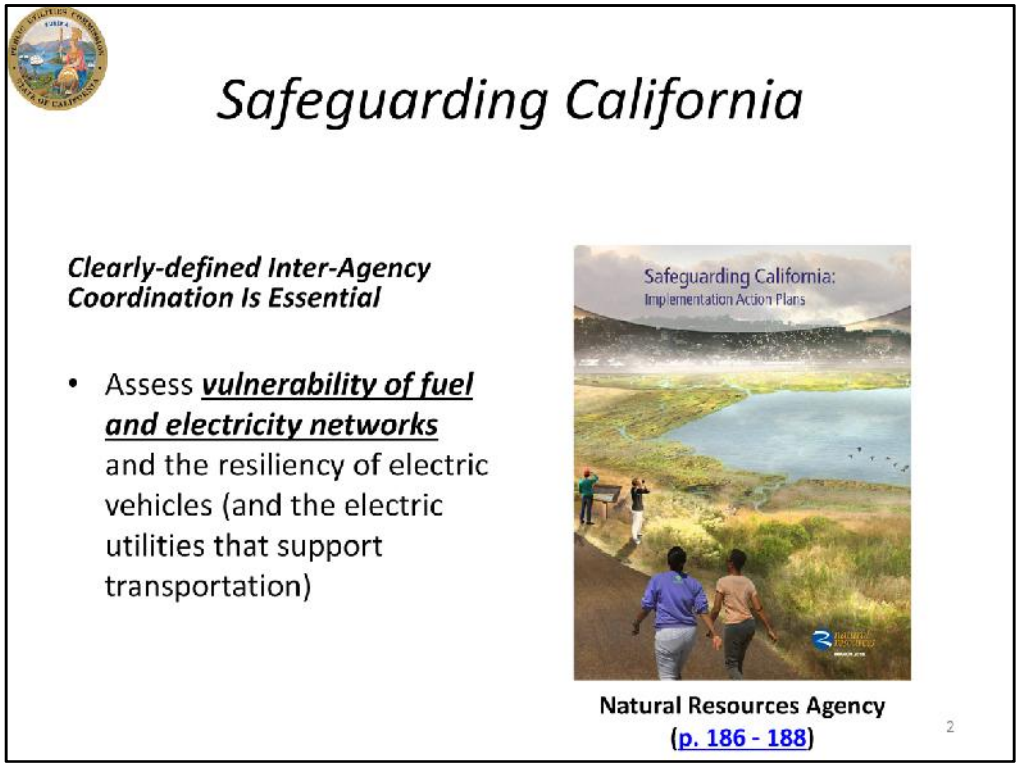

The purpose of today's workshop is to explore how to achieve the levels of transportation electrification needed to, consistent with the theme of a recent report from the Natural Resources Agency, **Safeguard Californians**.

We've assembled a great lineup of representatives of government, research, and utilities that have been working on the issue of Transportation Electrification from a variety of perspectives:

- Simultaneously reducing air pollution, greenhouse gas emissions, and petroleum use,
- Planning for and operating an electricity grid that will accommodate these new, diverse, and mobile electricity loads,
- Demonstrating zero-emission vehicle technologies and infrastructure, and subsequently deploying them into the market.

The Commission, with public input, will be calling for near-term utility programs that accommodate this diversity of experience and constraints. These programs will need to set us on a path for widespread transportation electrification.

- With that, I welcome **Commissioner Carla Peterman** will describe the Commission's objectives for Transportation Electrification, a new principal goal for the utilities.
- Cmr. Peterman will introduce Governor Brown's Senior Advisor **Cliff Rechtschaffen**, and Former Commissioner and current CAISO board member **Mark Ferron**, who will each provide introductory remarks.
- Finally **Administrative Law Judge John Wong** discuss what you can do provide feedback to us as participants to our policymaking.

Clean Energy and Pollution Reduction Act

Governor Brown signs SB 350, October 7, 2015
(California State Assembly Democratic Caucus)

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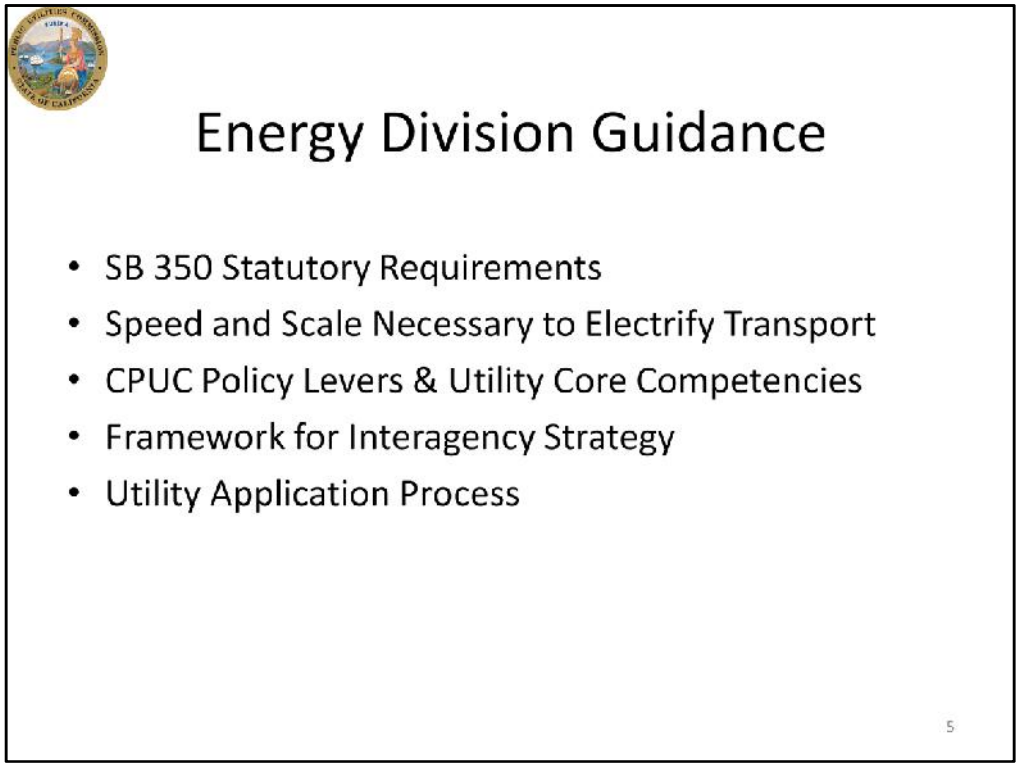
Noel Crisostomo & Amy Mesrobian,
Public Utilities Regulatory Analysts, Energy Division

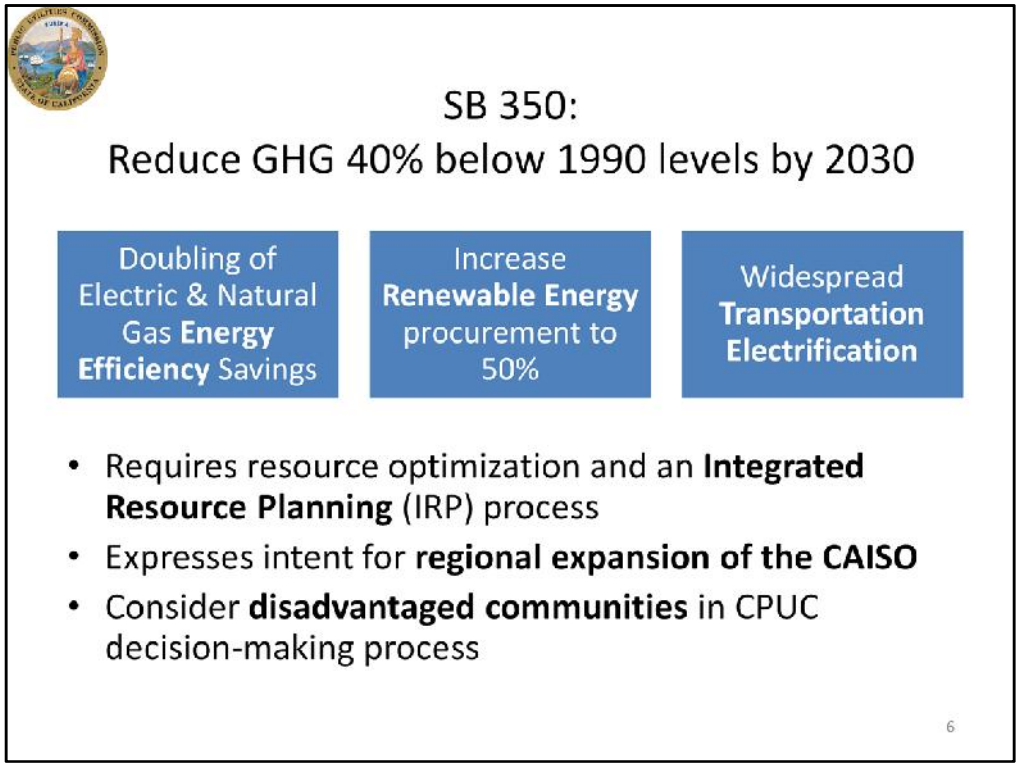
SB 350 REQUIREMENTS & GUIDANCE STRAW PROPOSAL



The goal of Energy Division's presentation is tie together much of the information you've heard today, and help you think about what the CPUC and IOUs can do going forward to increase transportation electrification.

We will start off with a basic overview of SB 350 and associated GHG and air quality goals, then discuss the potential role of the CPUC & IOUs and how we can best leverage the work of our sister agencies to promote transportation electrification.

Our talk is followed by utility presentations, after which we will open it up to the audience for discussion. If you have any questions for us about what we present here, please save those questions for the discussion period at the end of the day.



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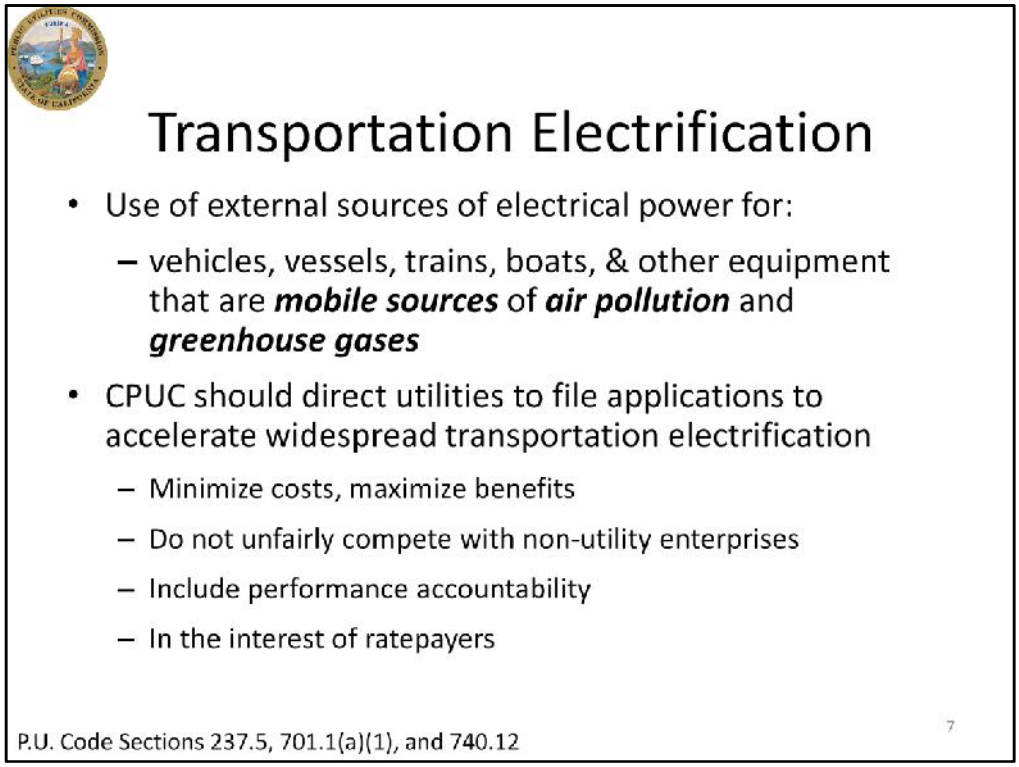
Senate Bill 350, the Clean Energy and Pollution Reduction Act of 2015, requires the CPUC to focus energy procurement decision on reducing greenhouse gas emissions by 40% by 2030, including the doubling of the rate of energy efficiency, increasing renewable energy procurement to 50% by 2030, and promoting widespread transportation, among other things.



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Transportation Electrification is defined as the use of electricity from external sources of electrical power, including the electrical grid, for all or part of vehicles, vessels, trains, boats, or other equipment that are mobile sources of air pollution and greenhouse gases and the related programs and charging and propulsion infrastructure investments to enable and encourage this use of electricity. (PU Code Section 237.5)

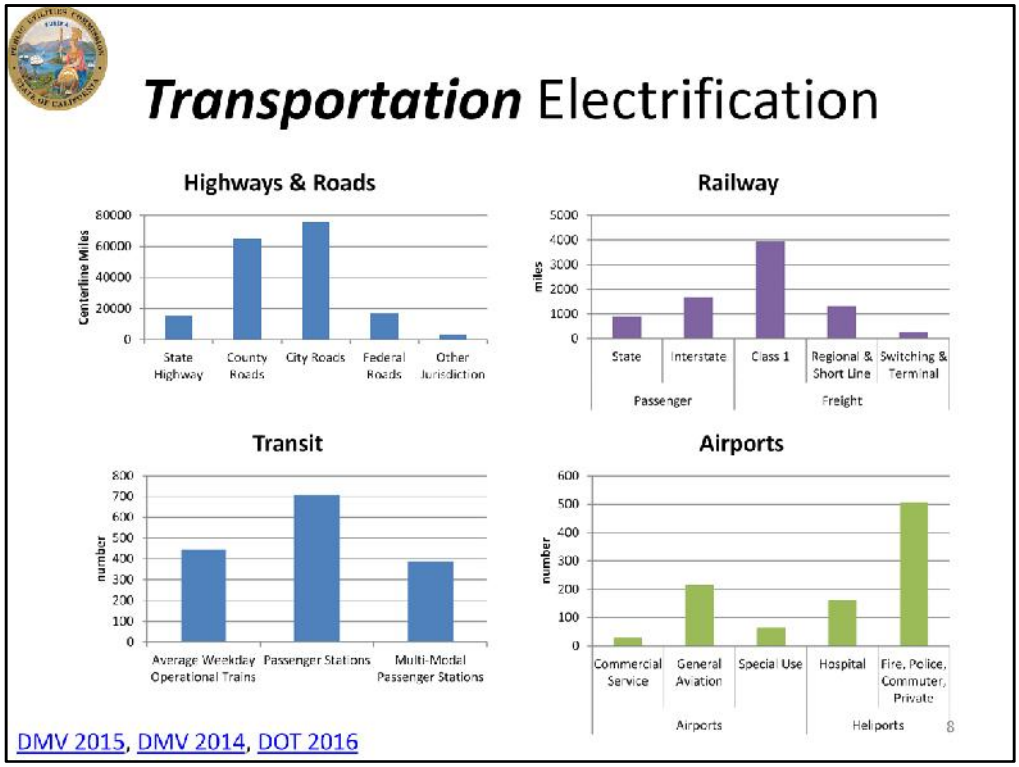
SB 350 found that widespread transportation electrification, like energy efficiency and development of renewable energy, should be a principal goal of electric and natural gas utilities' resource planning and investments, in addition to other ratepayer protections. (PU Code Section 701.1(a)(1))

SB 350 requires the CPUC, in consultation with ARB and CEC, to direct the electric utilities to file applications for **programs and investments** to accelerate widespread transportation electrification.

- The objectives are to reduce petroleum usage, meet air quality standards, improve public health, and reduce greenhouse gas emissions
- Programs must minimize costs and maximize benefits, not unfairly compete with non-utility enterprises, include performance accountability measures, and be in the interest of ratepayers

The Commission shall review data concerning current and future electric transportation

adoption and charging infrastructure utilization prior to authorizing an electric utility to collect new program costs related to transportation electrification in customer rates. If market barriers unrelated to the investment made by a utility prevent electric transportation from adequately utilizing available charging infrastructure, the commission shall not permit additional investments in transportation electrification without a reasonable showing that the investments would not result in long-term stranded costs. (PU Code 740.12)



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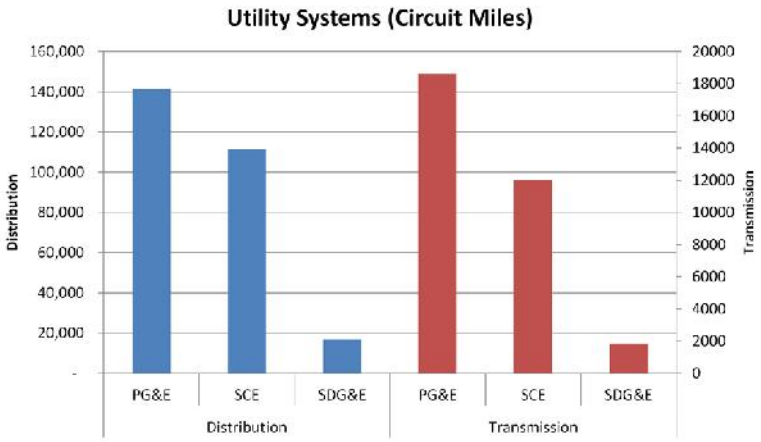
Looking at the transportation component of transportation electrification – we have diverse transportation infrastructure – roads, rail, public transit, airports, ports

Our transportation system is valued at over a trillion dollars. In California, there are 34 M registered vehicles & vessels 1.4 billion transit passenger trips annually

Transportation ***Electrification***



CEC 2014, PG&E, SCE, SDG&E

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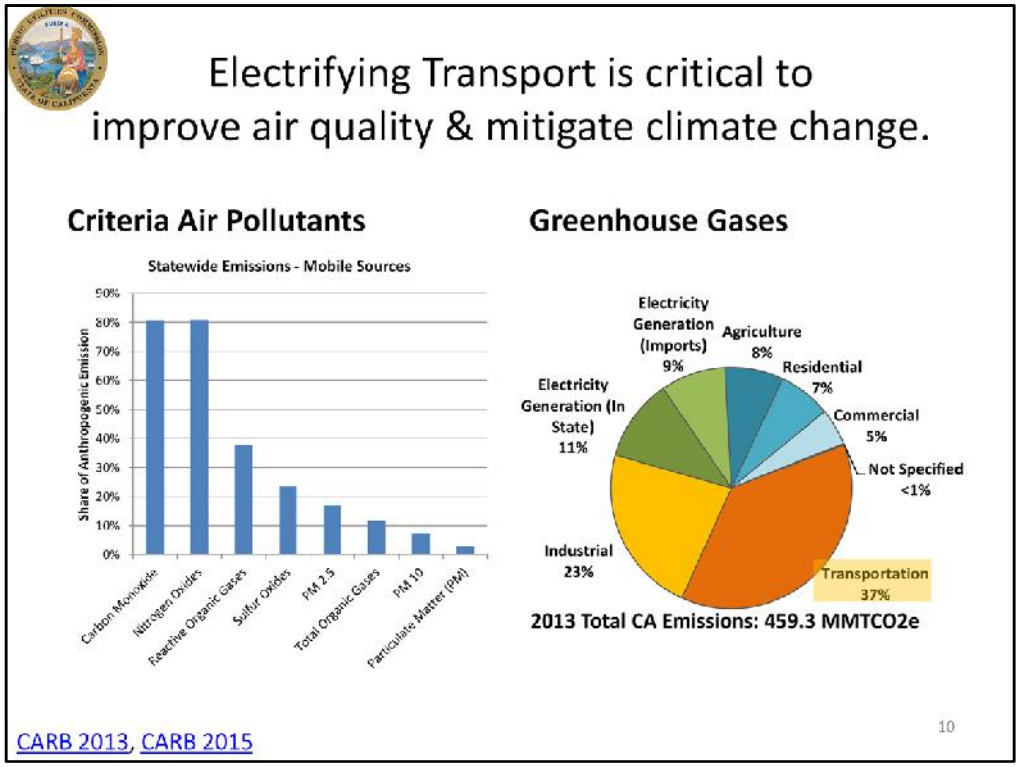
As the diverse transportation sector is electrified, it will need to be integrated into the electric grid, which is also an extensive network. The three large utilities, PG&E, SCE, & SDG&E that we regulate have hundreds of thousands of miles of transmission and distribution infrastructure throughout the state



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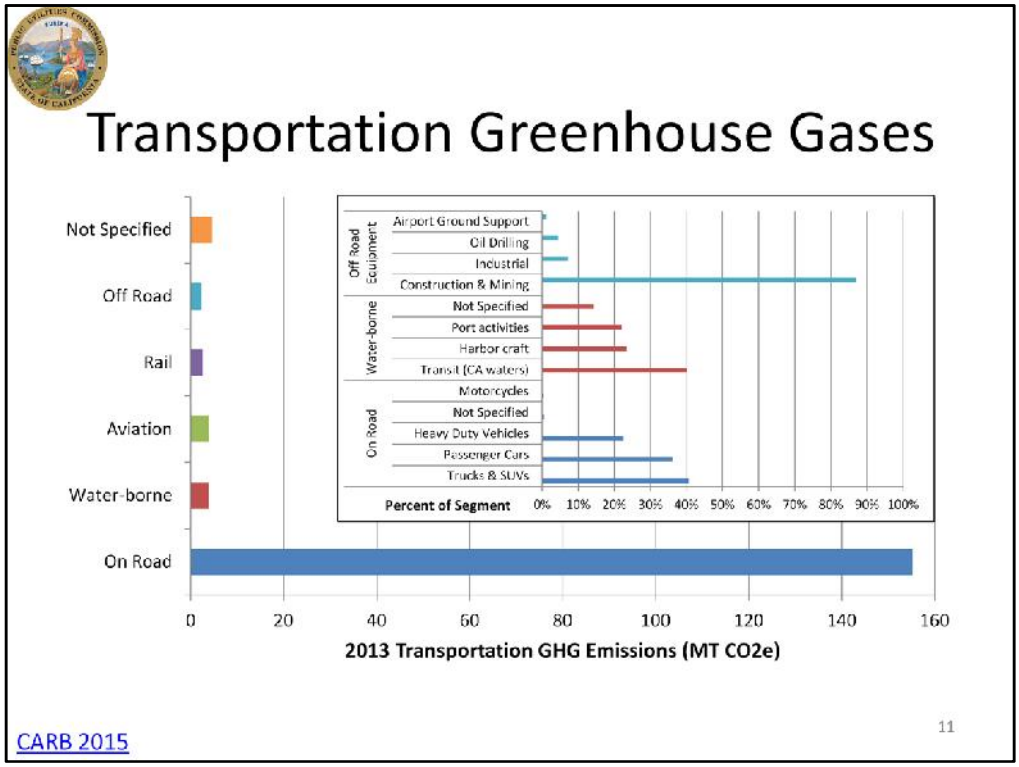
The switch from petroleum based transportation to one fueled by a renewably-powered electric grid is needed to meet the State's air pollution and greenhouse gas reduction mandates.

- As many of you know and as we discussed earlier today, transportation is the single largest source of the State's GHG, 40%, and higher if you include emissions from petroleum refining (included within industry).
- For criteria air pollutants, mobile sources contribute varying levels depending on type. Mobile sources comprise 80% of the anthropogenic Carbon Monoxide and Nitrogen Oxide emissions, that threaten public health.

Air Emissions (notes from ARB Glossary)

- Criteria Air Pollutants = O3, CO, NO2, SO2, PM10, PM2.5
- TOG = ROG + unreactive CH4 (methane)
- ROG = photochemically reactive Hydrocarbons that contribute to smog
- Smog = smoke, particulates, O3, ROG, NOx & other chemically-reactive compounds
- O3 = photochemical reaction where HC & NOx, health effects
- SOX = (CAP) health effects, damage vegetation, reduces visibility
- NOX = (CAP) smog, acid deposition (rain or aerosols), health effects, reduces visibility
- CO = (CAP) incomplete combustion of HC, health effects
- PM = (CAP) solid or liquid in the atmosphere. If <10 microns, "PM10" or if <2.5microns,

“PM2.5.” health effects, reduces visibility



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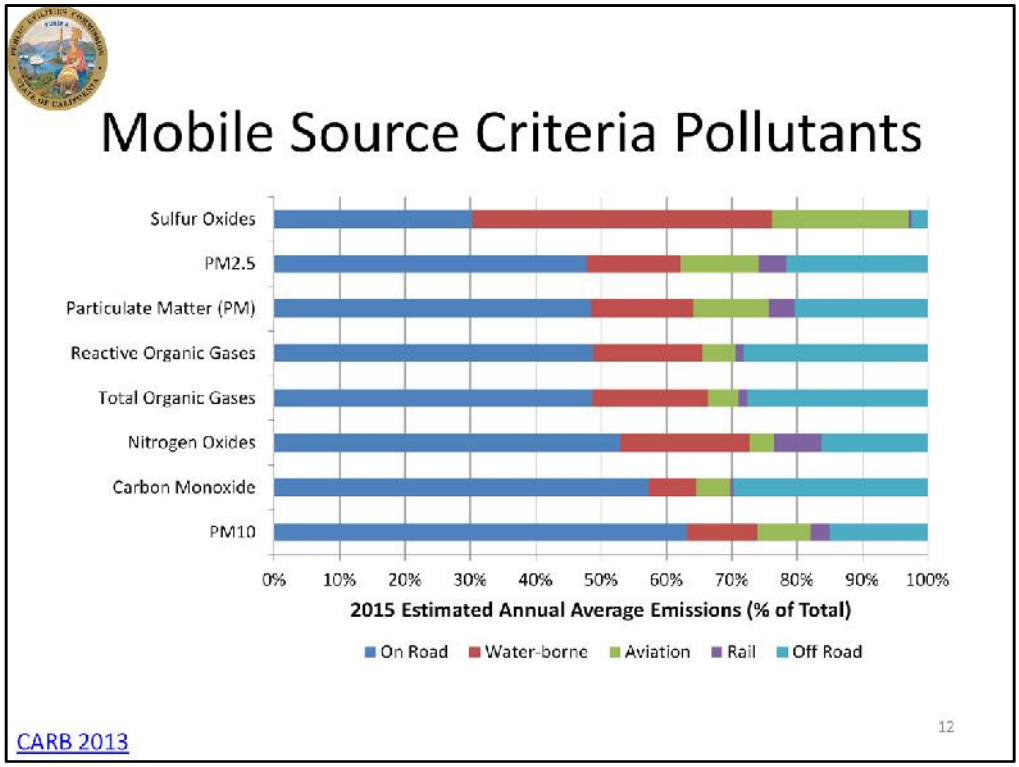
On-road segments (cars, trucks, heavy duty vehicles) account for 90% of GHG. Non-road segments (off-road, rail, aviation, and maritime) evenly split the remaining 10%.



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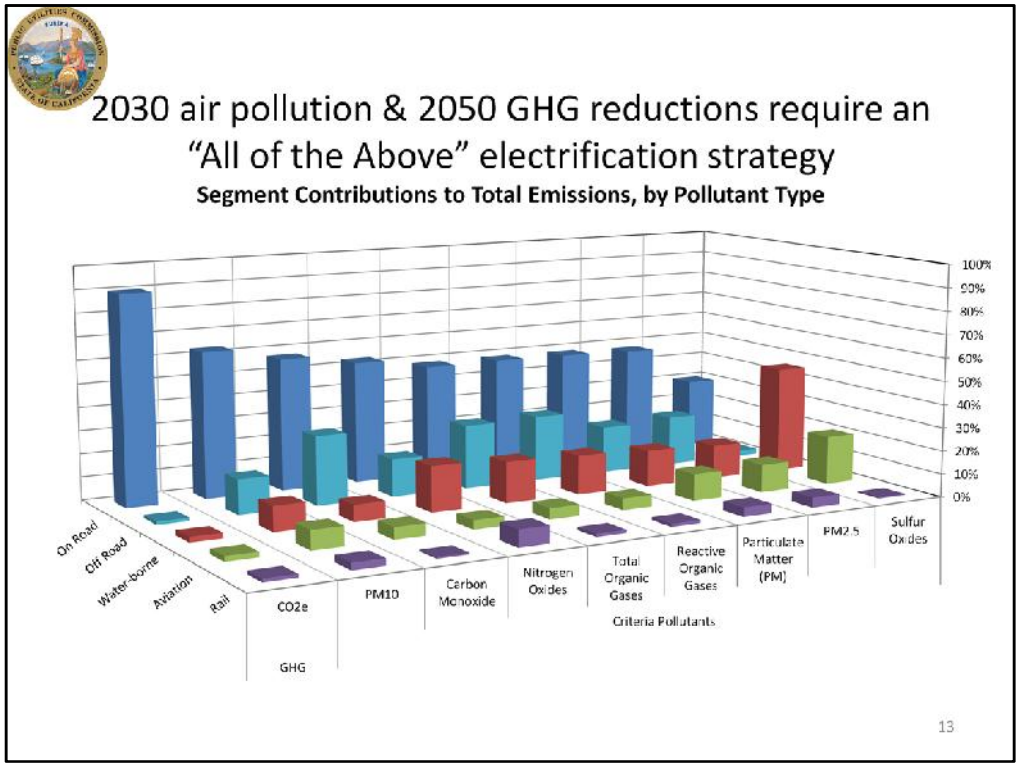
While on road vehicles are clearly the dominant source of GHG emissions, they contribute roughly half of each of the criteria pollutants.

Water-borne, air, rail, and off-road sources contribute varying amounts of pollutants, notably:

- water-borne emissions emit nearly half of the Sulfur Oxides.
- Off-road vehicles emit 30 percent of Carbon Monoxide and Organic Gases.



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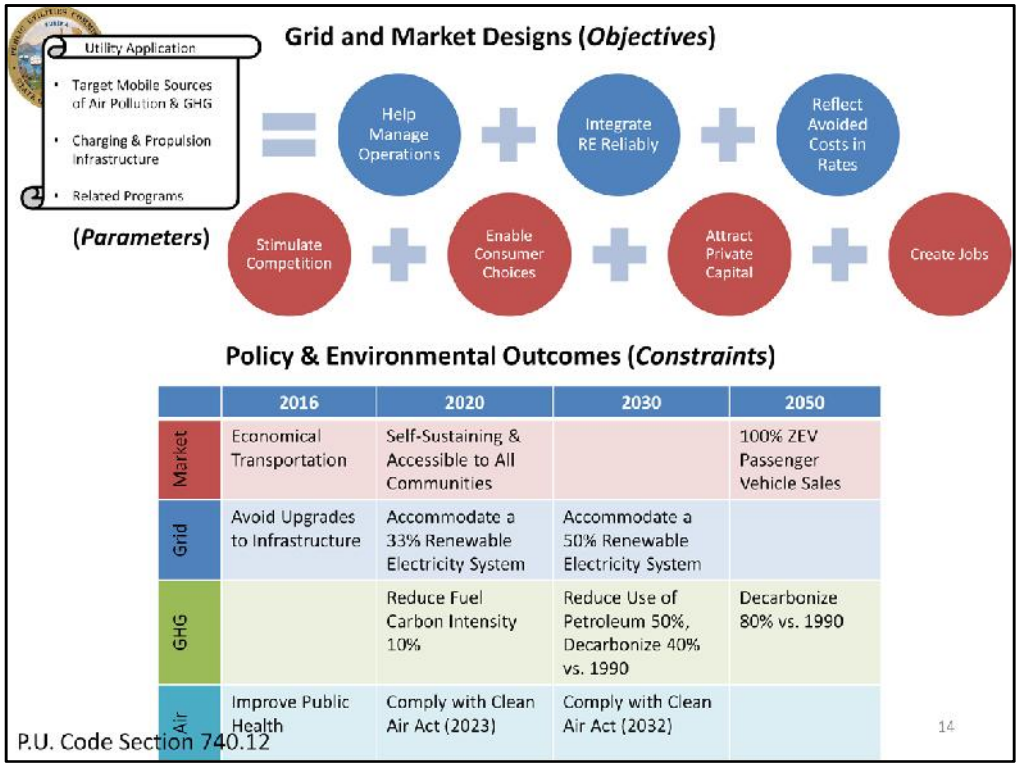
All segments are needed to achieve the multi-objective goals of SB 350:

- B-16-2012 encourages an 80% reduction in Transportation GHG by 2050. In concept, that could be addressed by eliminating all GHG from the on-road sector.
- However, SB 350's additional focus on air pollution becomes the binding constraint. The non-attainment areas of the state, which have Federal Clean Air Act deadlines decades earlier, require more immediate immediate action.
- e.g. Per the Mobile Source Strategy, South Coast AQMD is mandated to reduce smog forming emissions 80% by 2030. Assuming that this surface is representative of South Coast's emissions, the district would not be able to comply with the Clean Air Act without addressing the off-road, water-borne, aviation, and rail sectors.

It is possible that for non-road sectors there are fewer decision-makers and individual pollutant sources, decreasing the transactions needed to electrify.



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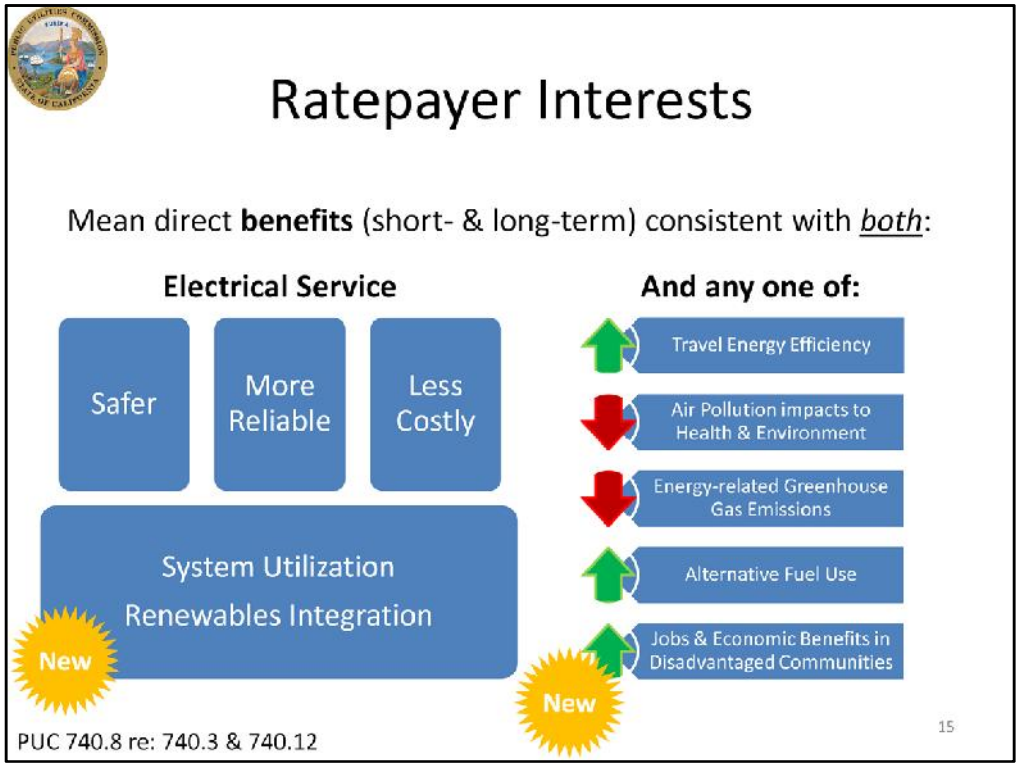
How do we design these immediate, 2-5 year programs?

SB 350 requires the utilities' Transportation Electrification initiatives to be designed with several grid and market growth considerations:
Electrification should

- allow drivers to save money if the contribute to grid operations management and renewable integration.
- promote a diversity of suppliers, customer choice, investment and industry to facilitate this market

The policy objectives are well known by you all, but I'd like to highlight the needs to develop a more accessible market by considering the needs of disadvantaged, low, and moderate-income communities that are impacted most by air pollution and most burdened by transportation costs.



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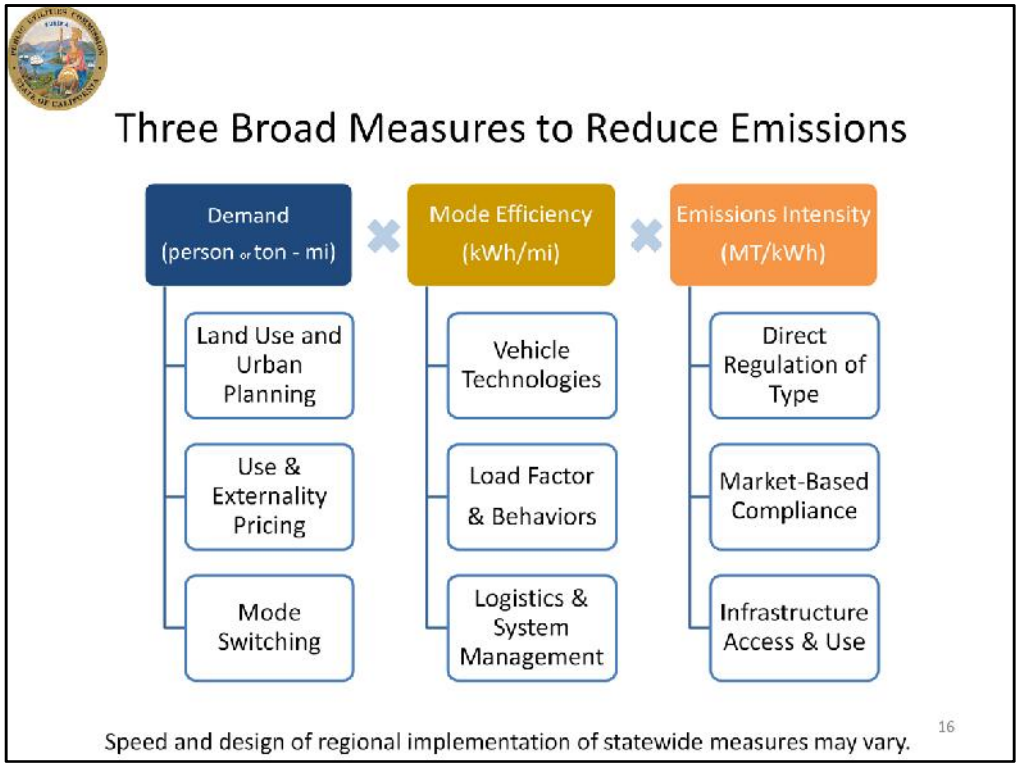
In addition, these programs must directly benefit the customers that will be responsible for the repaying investments deployed on their behalf. This section of code was restructured to clarify that improvements to the safe, reliable, and economic provision of electricity could be attributed to electrification if they can be found to improve the system's load factor or ability to accommodate renewables – key goals for Vehicle Grid Integration. The amendment also the included the development of the electrification industry in disadvantaged communities as a ratepayer benefit.



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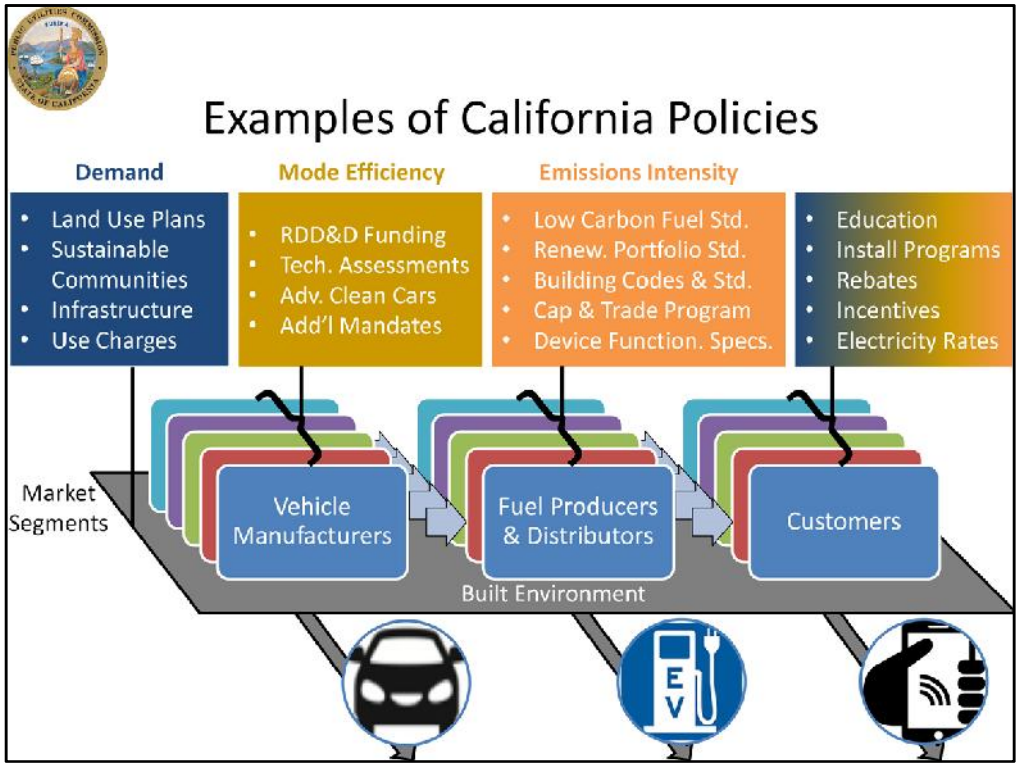
I'd like to emphasize how some of the greatest opportunities to lever TE are the expanse of complementary policies at each of the agencies that seek to simultaneously

- reduce travel demand,
- improve the efficiency of our vehicles and the systems within which they travel,
- minimize the emissions needed to produce fuel

As we'll discuss in the final slides, CPUC's jurisdictional authority is best situated to address emissions intensity by decarbonizing and improving access to electricity.



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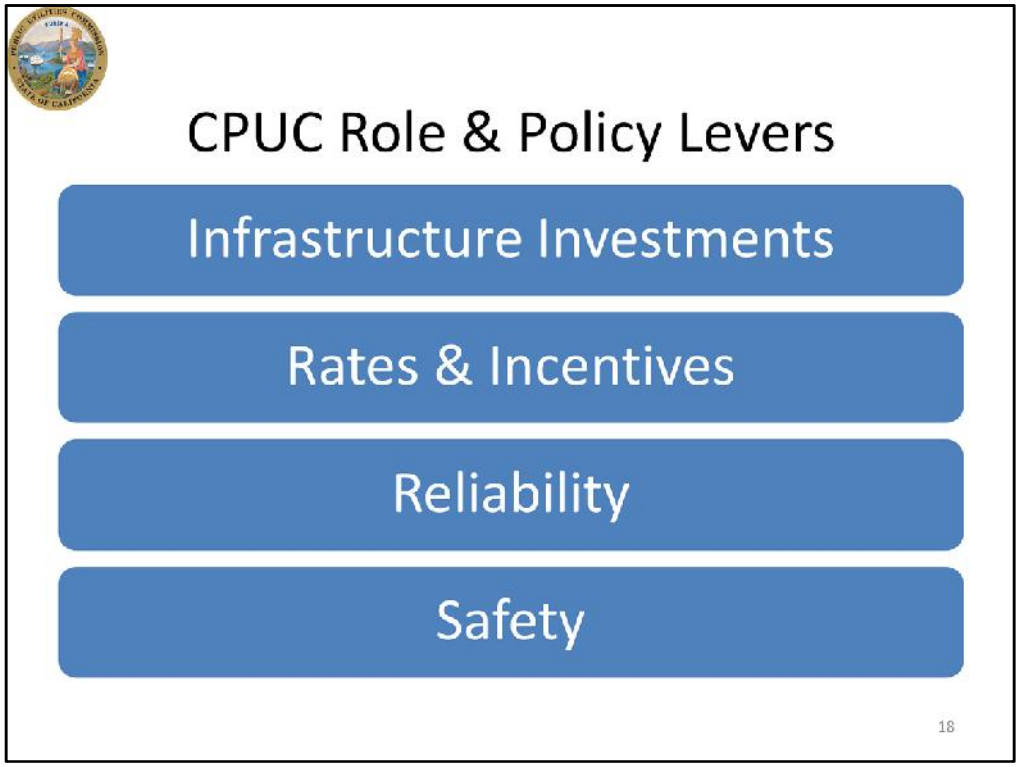
Here I provide a policy model of where State initiatives apply within the transportation ecosystem and their results
State policies targeting:

- Demand reduction apply primarily to local bodies responsible for the design of the built environment
- Vehicle production and sales apply to automotive manufacturers. However, cost reductions are enabled through R&D funds and other incentives.
- Fuel type and content primarily apply to energy producers and distributors- in this case power generators, utilities and charging companies.

In tandem, these policies touch customers with demand-pull programs which result in the deployment of more vehicles, infrastructure, and hopefully, connectivity with each other and the grid that underpins them.



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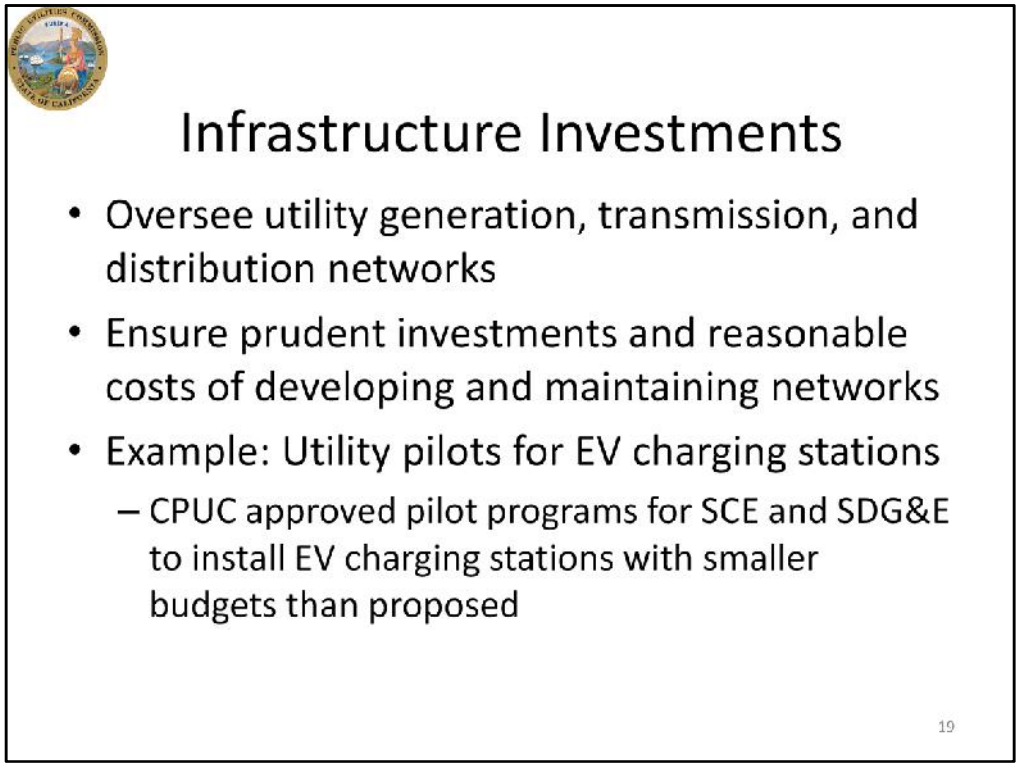
Now I'll discuss how can we best leverage the CPUC and IOUs' roles of providing safe, reliable, affordable service to promote TE. I'll explain our core competencies and the four main levers we may have to accelerate transportation electrification: infrastructure investments, customer rates and incentives, reliability, and safety. For each, I'll pose questions you may want to think about as you consider these policy levers in the forthcoming utility TE applications.



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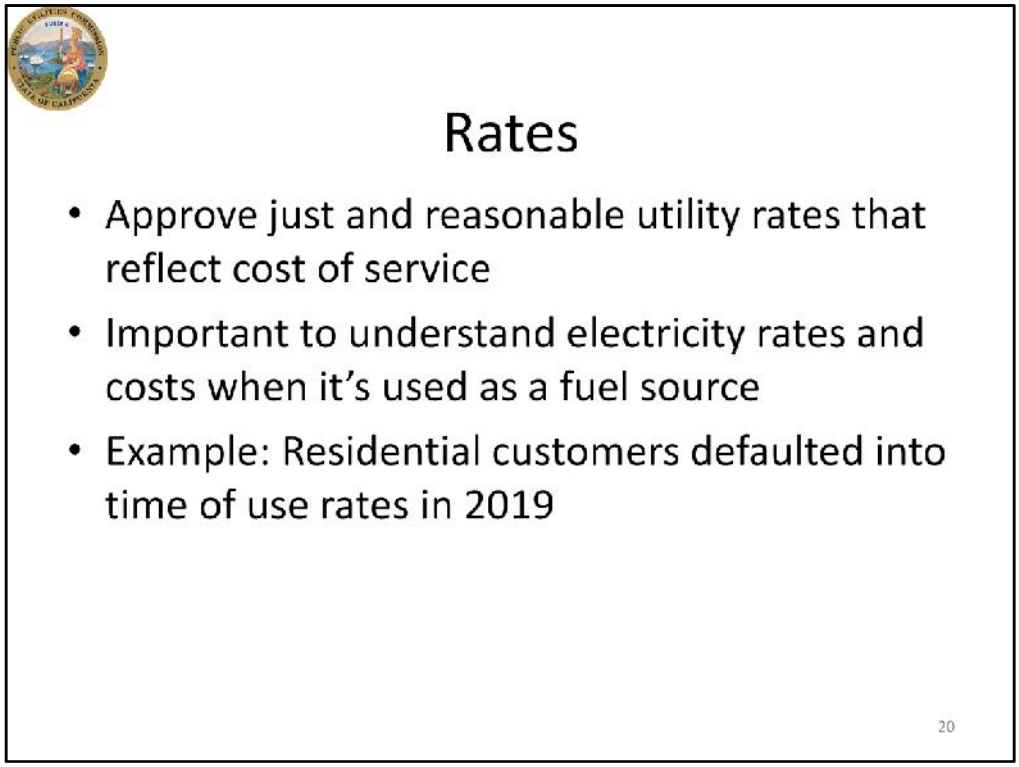
Utilities invest in the infrastructure necessary for electric generation, transmission, and distribution. Generally, these investments are included in their rate base, on which they earn a return on investment. As customer rates are based on these costs, the CPUC ensure prudent investments and reasonable cost of developing, operating, and maintaining this infrastructure.

For example, In January, the CPUC approved SCE's and SDG&E's pilots to invest in the infrastructure needed to support increased deployment of electric vehicle charging stations.

The Commission approved smaller than proposed pilots to help ensure fair competition, specific and measurable outcomes for which utilities are accountable; and protect the interest of ratepayers.

Thinking about potential utility infrastructure investments, Question for consideration: what are the ratepayer benefits of infrastructure investments, how much do they cost, and who should pay for them? Are there additional funding sources we can leverage? How do we ensure these programs are in the interest of ratepayers, especially in disadvantaged communities? How do we consider research and development and emerging technologies in our infrastructure planning to ensure we are building the grid of the future and making the right investments?



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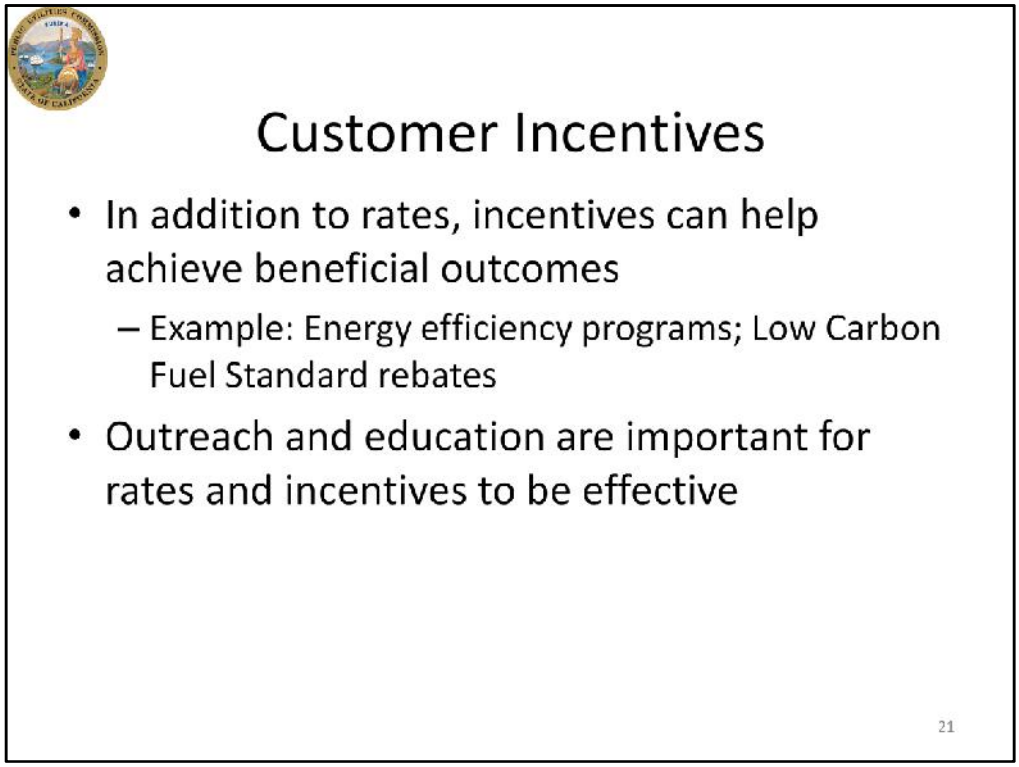
Next, I'll talk about customer rates and incentives, which are pricing mechanisms that can encourage beneficial outcomes, and optimal grid use

One of the core functions of the CPUC is to regulate utility rates. We design rates to reflect the costs to serve customers.

As we switch from petroleum fuels to electricity as a fuel for transportation, understanding electricity rates becomes increasingly important to understand transportation fuel costs. For example, as Tony from ARB mentioned this morning, we've recently heard from transit agencies that operate fleets of buses and have begun switching from diesel to electric buses, that demand charges are challenging for them. Aligned with our cost of service ratemaking principles, demand charges are a component of existing rates that recover costs of the capacity of the grid needed to support maximum electrical demand. (If everyone is using electricity all at the same time, we need a bigger and more expensive grid to serve those loads, but if demand is more spread out, the grid can be smaller and less costly) Going forward, we want to think about how to best work with IOUs and customers to better understand and plan for using electricity as a fuel source, and determining technological or financial strategies available to optimally use the grid and keep fuel costs low. For example, are there software systems, ways to pair energy storage systems, or market solutions that help provide more stability in electricity fuel costs

(even if the underlying rates are complex)? How can we create a market to allow third party investment to provide these solutions.

In July of last year, the Commission issued a residential rate reform decision to allow for more accurate allocation of costs and for energy rates to more fairly reflect the cost of service. Among other things, the decision directed the IOUs to begin a default TOU rate structure for residential customers beginning in 2019. A goal for implementing TOU rates is to provide a price signal that customers can understand and respond to in a way that reduces the cost and environmental impact of energy use. It's a way to incentivize ratepayers to achieve a beneficial outcome. We need to consider changes in rate structures like this as think about future investments.



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In addition to rates, incentives can help achieve beneficial outcomes.

CPUC authorizes some incentive programs to influence customer behavior. Energy efficiency incentives for example, can incentivize customers to purchase more energy efficient products, reducing demand on the grid and avoiding the need for costly new generation and transmission. These incentives can reduce a customer's energy bills as they consume less energy, without changing their rates or tariffs.

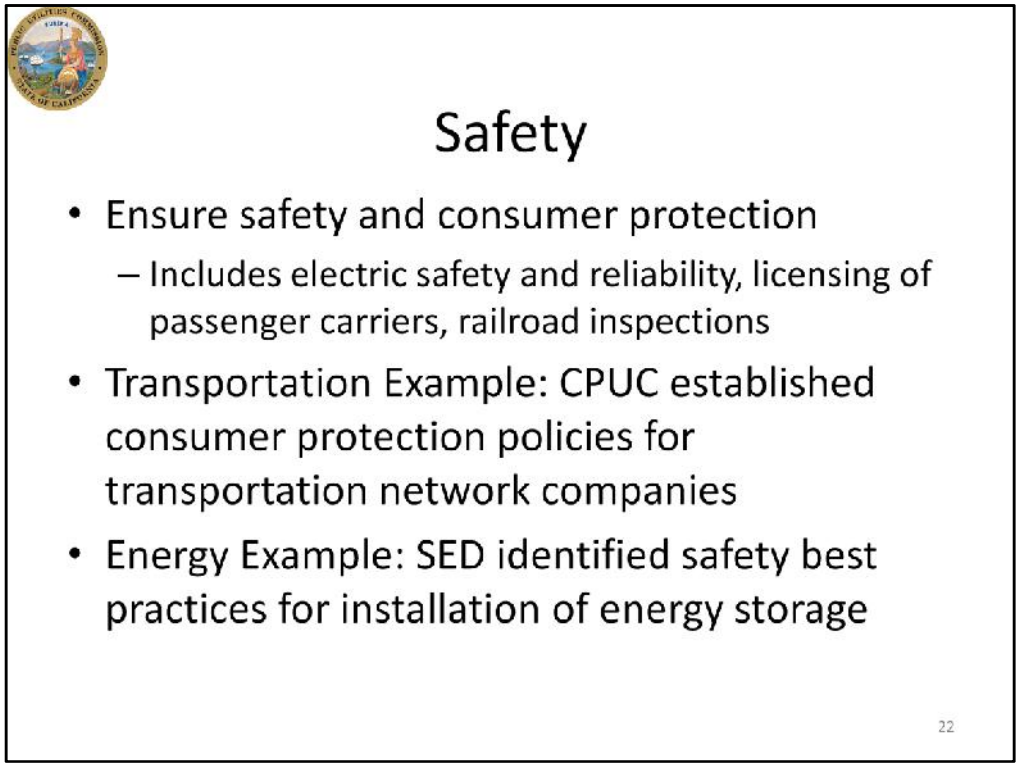
For another example of a new incentive program, through the state's Low Carbon Fuel Standard (LCFS) Program, electric utilities use the revenue they receive from LCFS credits to benefit their electric vehicle drivers by either providing a rebate on the purchase of an electric vehicle (PG&E, SCE) or an annual rebate to electric vehicle drivers (SDG&E). Utility participation in the LCFS program and distribution of these credit revenues reduces the total cost of EV ownership, helping more drivers own Evs. Financial incentives to customers can help them adopt new technologies or behaviors to save energy or reduce their impact on the grid, ultimately reducing greenhouse gas emissions.

Outreach

Customer awareness and engagement are key to helping them understand rates and incentives and better manage their energy. In the Low carbon fuel standard

example, customers need to know about the LCFS rebate for it to influence their behavior.

Thinking about customer rates and incentives as a way to increase transportation electrificaiton, Questions for consideration: Are there rates and incentives that can accelerate transportation electrification and also reduce overall costs? How should they be designed to maximize customer understanding? What types of outreach do we need to ensure these are effective?



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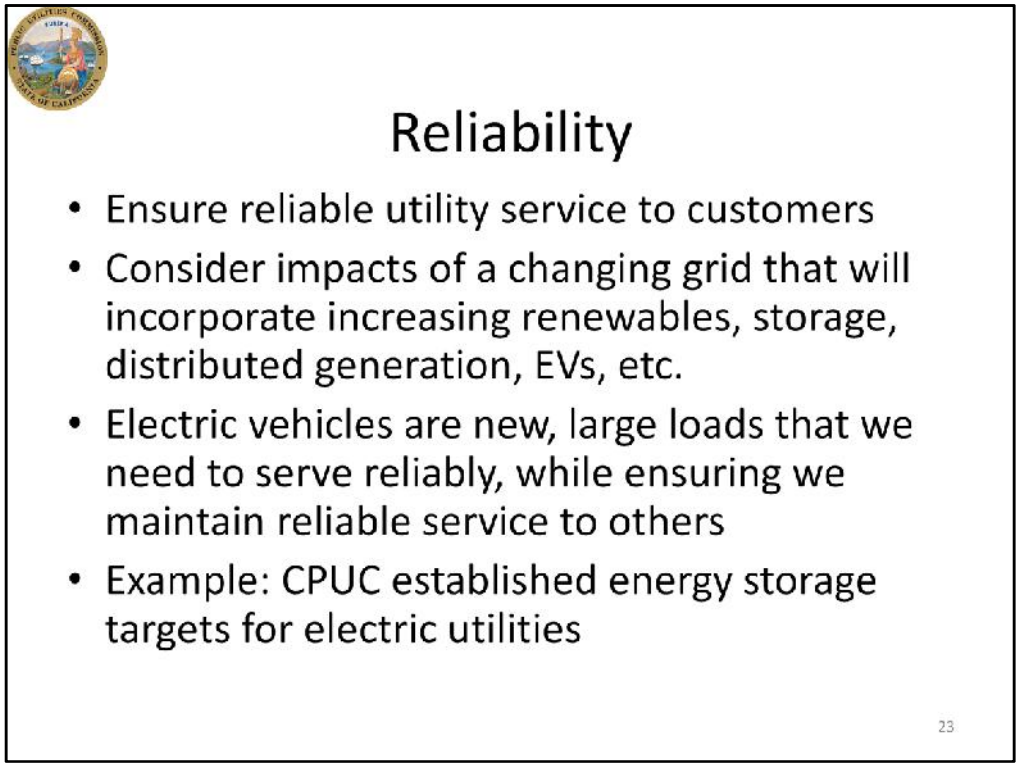
The CPUC incorporates safety and consumer protection into all aspects of our work.

Our Safety and Enforcement Division of the CPUC works on both electric safety and reliability issues, and transportation related work including rail safety, and oversight of for-hire passenger carriers (limousines, airport shuttles, charter and scheduled bus operators), transportation network companies (an emerging industry), moving companies, railroads, light rail transit agencies, and rail crossings

Question: As we continue to electrify the transportation sector, and the transportation and electric systems begin to converge, what new safety and consumer protections are necessary? CPUC hosted a thought leaders session a few months ago looking at the future of autonomous vehicles. How do we consider emerging transportation trends and technologies like these and keep up with the safety aspects of these innovative ideas?



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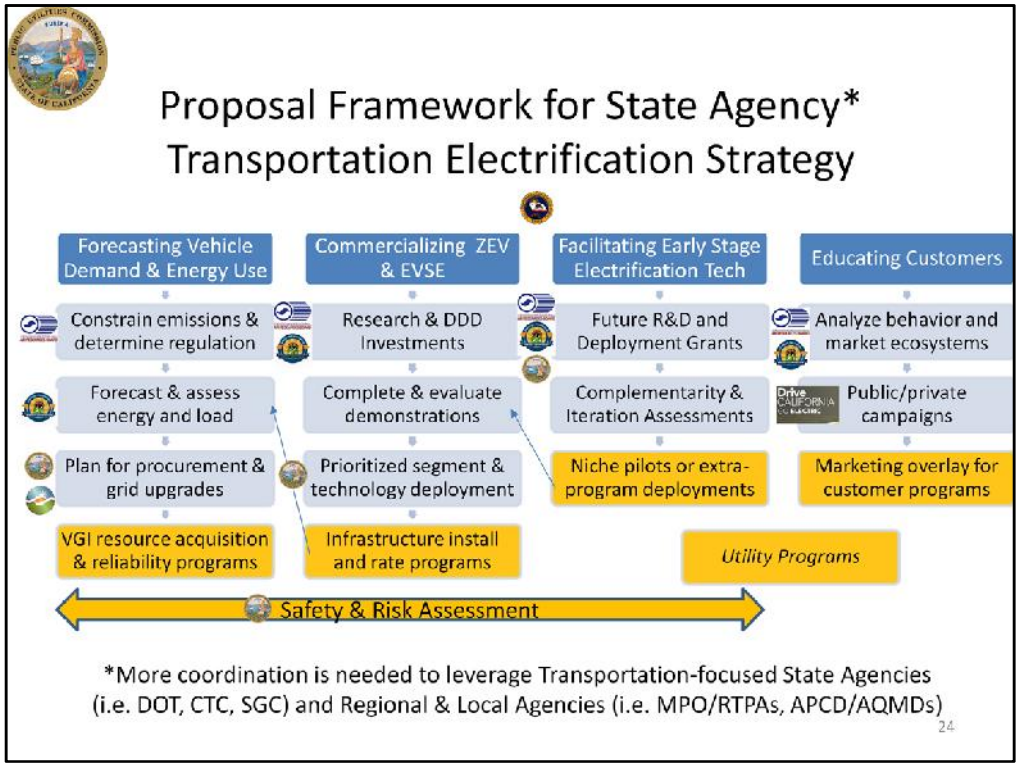
In short, reliability means keeping the lights on. It's delivering uninterrupted electric service to customers, and minimizing outages. As the grid continues to evolve and both load and generation change, we must understand the implications for reliability. The grid is accommodating an increasing amount of renewables, energy storage, distributed generation, and electric vehicles. As electric vehicles are added to our grid, we need to serve them reliably while at the same time continuing to provide reliable service to existing loads.

Example of CPUC policy to promote reliability: in 2013, CPUC established an energy storage target for the electric utilities to help optimize the grid and promote reliability, help integrate renewables, and reduce greenhouse gas emissions. V2G capable vehicles could count towards this target. A recent ruling in the storage proceeding, parties have expressed interest in permitting V1G (i.e. managed charging) to be eligible for storage procurement. The CPUC is still considering this issue.

Question: as more cars, boats, trains, ports, etc. are using electricity as a fuel source, how does that impact the grid? How can transportation electrification be appropriately located to minimize negative impacts to the grid? And one step further, how can electric vehicles provide grid resources – this is the essence of vehicle grid integration or VGI. How do we account for VGI resources in our

procurement planning processes? What standards do we need to set for utility procurement of infrastructure to enable VGI and improve grid operations?



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The challenge for the agencies, regulated automakers and utilities, market participants that charge and aggregate vehicles, and drivers/passengers alike has been how to build clear policy structures, business plans, and purchase decisions in a way that accounts for these seamlessly. SB 350 gives the CPUC the clear directive as one of the lead agencies to coordinate transportation electrification from the electric utilities' perspective, but the other agencies have important roles to play. The utilities should leverage the State's planning and process efforts in a more integrated fashion, and we've categorized them here, broadly in a Framework for Transportation Electrification Strategy.

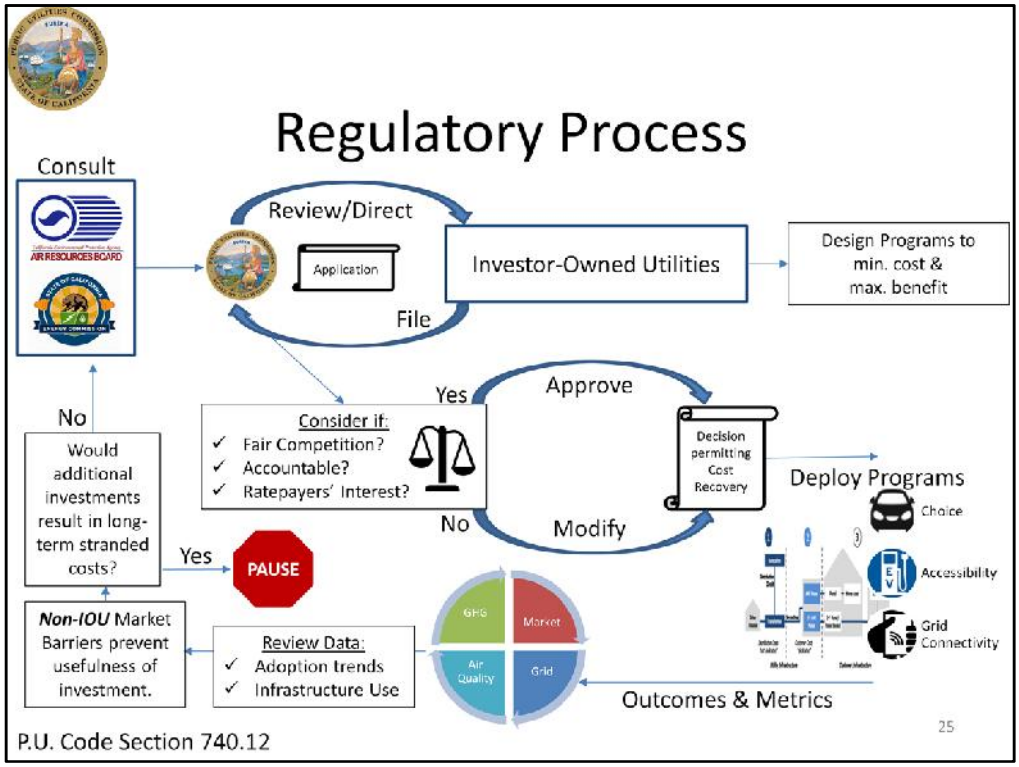
There are 4 key areas of interagency coordination:

- To **Forecast Vehicle Demand and Energy Use**, the State could sequence an assessment where the CARB constrains pollutant and GHG emissions to determine associated supply push regulations. The IEPR could use those as inputs to forecast and assess energy and load which is considered when CPUC and CAISO make generation and transmission procurement decisions. Capacity additions could be mitigated by the utilities targeting Vehicle-Grid Integration resource acquisition programs similar to energy efficiency that shift load or are deployed as distributed resources to improve reliability.
- The second area aims to use utility programs to **commercialize innovations out of the labs and universities on to our roadways and garages**. The Alternative and Renewable Fuel and Vehicle Technology Program, and more recently, the Greenhouse Gas Reduction Fund and Electric Program Investment Charge each play critical parts in

fostering new technology and projects, but we can do more to realize the return on ratepayers' and fee-payers' investments. There should be a timelier method of evaluations, prioritization, and identification of vehicle, equipment, and software/control technologies that can be referenced and leveraged in our infrastructure installation and rate designs.

- The third area is slightly different than the second in that it **facilitates earlier-stage technologies and business models**. The operative point here is the need to ensure that the state's generations of investment plans are rigorously mapped among existing demonstration or deployment efforts to identify appropriate niche tests that aren't ready for full-scale deployment. For example, what would a gas station-like set of 300 kW DCFCs do to a predominantly commercial customer feeder? How do we leverage autonomous cars as EV DERs with much greater reliability?
- The fourth foundational area underlies all utility programs, but given the great research being completed to analyze customer preferences and participants in the CVRP, we should explore how the agencies can best share data to reduce uncertainties, **design powerful messages with private industry, to eventually ensure successful enrollment campaigns** for when we want cars to, for example behead the duck by discharging their batteries with V2G.

Lastly, and to connect to Rebecca's recommendations about transportation planning, these four areas focus primarily on the fuel efficiency and emissions measures that the principal energy agencies are responsible for, but it is clear that we should integrate land use, Sustainable Communities Strategies, into our planning.



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We will conclude by outlining the regulatory process for transportation electrification applications, which will foray into the utilities' presentations well.

- The CPUC is here, now consulting with sister agencies and the public for purposes of directing the utilities' applications for widespread transportation electrification.
- After they design programs, they will file them with us, at which we will consider them against the criteria of fair competition, accountability, and being in the ratepayer interest.
- Many of you are familiar with the fine details our balancing test through the more than three weeks of evidentiary hearings we've held on the $1B proposals for LDV EVSE. If the nature of the utility programs does not unfairly compete with private enterprises, the Commission could approve a decision authorizing cost recovery. If not, the Commission is required to impose restrictions or regulatory protections to balance the program.
- After deployment of vehicles, infrastructure, or other programs are measured from the 4 policy constraints, the Commission will review adoption and utilization data.
    - If we identify that **market barriers external to** the nature of the IOU program prevent its effectiveness, we are required by this section to consider whether or not additional investments of that nature would result in long-term stranded costs. If yes, we should pause and consider. If not, we may iterate with additional programs.
    - This last point about program evaluation, measurement, and verification will be

challenging when the State contemplates scale, since EM&V is a double-edged sword. Despite the principal need to ensure prudent expenditures and continuous program improvement, applying EM&V to utility electrification programs at this early stage of a new market may be challenging because charging infrastructure and rates are just one side of the equation in a customer's decision to purchase a vehicle.

- Vehicles are a large investment. They express a person's individuality and decisions are made upon many factors that are not based on hyper-rationality. Logit choice and revealed preference models are imperfect and entire teams at national labs and universities dedicate time on these. In addition, we as regulators and you as parties need to react not only to utility offerings, but those of actors in the private market: automakers and charging equipment providers.
- Due to these realities I caution against beginning, as someone during PG&E's Evidentiary Hearings yesterday said, "a war of attrition" needed to, for example, determine a net-to-gross or adoption factor for each EVSE installed. Given that multiple levels of government have established so many means of attacking the transportation emissions problem, this will be a challenge. However, we look forward to considering your recommendations to design a just, effective, and cohesive Strategy to Fuel the Future.

This is a question that will warm up the panel and we will take questions from the audience (2 min each so that we have enough time for everyone)

Given the statutes, what are the risks associated with pursuing /accelerating widespread Transportation Electrification?
(from different perspectives: technology deployment, ratepayer investment in infrastructure)

How does the utility manage the risk in the deployment of programs,
How should the Commission quantify the risk, especially considering weighing immediate (rate impacts) vs long term policy objectives (market transformation)?

Questions for Stakeholders

- In what ways should the Application Guidance Straw Proposal in Appendix A of this Scoping Memo be modified to better align with the mandates of SB 350?
- In light of current industry development and technology availability, should the Commission examine particular transportation sectors or market barriers first (e.g., light, medium or heavy duty vehicles, or specific applications), and why?
- What needs for standards development, research and development, or pilot projects exist that should be addressed by the Commission? What ongoing initiatives may be ready for increased scale?
- What should the application guidance ruling consider about the issues raised in the ARB workgroup meeting of April 8, 2016, and the issues raised at the April 29, 2016 workshop?

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NEXT STEPS & WRAPUP

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Upcoming Deadlines

- Comments filed formally
  - Opening due May 18
  - Reply due May 31
- Energy Division considers comments and builds upon Guidance for Utilities Q2-Q3 2016
- Assigned Commissioner Ruling inviting utilities' Transportation Electrification applications in Q3 2016

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Thank you!

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