



California Transportation Commission

Senate Bill 671 Workgroup

Tuesday, September 27, 2022

1:00 pm – 4:00 pm, in-person only

Cal/EPA Building – Byron Sher Auditorium

1001 I St, Sacramento, CA 95814

Agenda

Time	Topic
1:00 – 1:10	• Welcome & Opening Remarks
1:10 – 1:15	• Walkthrough of agenda
1:15 – 1:55	• Brainstorm Session Topic #1: Hydrogen and electricity production and distribution*
1:55 – 2:15	• Networking and information sharing
2:15 – 2:45	• Brainstorm Session Topic #2: Grant Funding*
2:45 – 3:15	• Networking and information sharing
3:15 – 3:45	• Brainstorm Session Topic #3: Total cost of ownership of zero emission trucks*
3:45 – 4:00	• Closing

****See attached pages for detailed prompts. These questions will guide the in-person conversation during the brainstorm sessions.***

Upon request, the Commission will provide assistive services including translation and interpretation in multiple languages, large print, digital audio and/or video recordings, as well as Commission meeting materials in an accessible format for the visually impaired. To obtain services or copies in one of these alternate formats or languages, please contact us at (916) 654-4245 or ctc@catc.ca.gov. Arrangements should be made as soon as possible but no later than at least five working days prior to the scheduled meeting.” (*Las solicitudes de acomodación especial o servicios de interpretación deben hacerse tan pronto como sea posible o por lo menos cinco días antes de la reunión programada*)

CALIFORNIA TRANSPORTATION COMMISSION STAFF CONTACTS:

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Topic #1 Hydrogen and electricity production and distribution

The following questions will guide the in-person conversation during the brainstorm session:

- What would an ideal system look like from beginning to end (including producing electricity and hydrogen. We know that the CEC, CPUC, and Cal ISO work with utilities to build infrastructure. How do private companies participate in this process?)
- What are key challenges and opportunities in the production of hydrogen and electricity?
- Are there new alternative energy or hydrogen projects you would like to highlight?
- How would you recommend industry or the government drive the cost down for hydrogen on a per kg basis for freight (Class 5 – 8 vehicles, such as long-haul trucks or drayage trucks).
- The cost of fuel is a mission critical cost that influences many business decisions. Going into a business setting, the cost of fuel will trump many things, except perhaps value of time (cost of an employee etc.). What is a possible plan to ensure the total cost of Hydrogen, including taxes, is competitive with gasoline and diesel? Should this be ensured?
- What other questions should we be asking?

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Topic #2 Grant Funding

The following questions will guide the in-person conversation during the brainstorm session:

- What are your biggest challenges when applying for funding in California? What are your ideas for improving it?
- Assuming we cannot have just one form for all grant programs, what are some other strategies we can employ?
- What are some commonalities of the various zero-emission infrastructure grant applications that we have provided as examples?
- What other questions should we be asking?

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Topic #3 Total cost of ownership of zero-emission trucks

The following questions will guide the in-person conversation during the brainstorm session:

- What potential solutions do you see to address the total cost of ownership? Does your organization have any specific approaches to share?
- What are the differences in cost between zero-emission drayage trucks and zero-emission long-haul trucks?
- What leasing options does your organization plan to implement, if applicable?
- What other questions should we be asking?

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1:55 – 2:15	Networking and information sharing
2:15 – 2:45	Brainstorm Session Topic #2: Grant Funding*

(Continued on next slide)

Agenda (continued)



Time	Topic
2:45 – 3:15	Networking and information sharing
3:15 – 3:45	Brainstorm Session Topic #3: Total cost of ownership of zero emission trucks*
3:45 – 4:00	Closing



Topic #1

Hydrogen and Electricity Production and Distribution

Topic #1: Hydrogen and Electricity Production and Distribution



What would an ideal system look like from beginning to end (including producing electricity and hydrogen)?

We know that the CEC, CPUC, and Cal ISO work with utilities to build infrastructure. How do private companies participate in this process?

Topic #1: Hydrogen and Electricity Production and Distribution



What are key challenges and opportunities in the production of hydrogen and electricity?

Topic #1: Hydrogen and Electricity Production and Distribution



Are there new alternative energy or hydrogen projects you would like to highlight?

Topic #1: Hydrogen and Electricity Production and Distribution



How would you recommend industry or the government drive the cost down for hydrogen on a per kg basis for freight (Class 5 – 8 vehicles, such as long-haul trucks or drayage trucks)?

The cost of fuel is a mission critical cost that influences many business decisions. Going into a business setting, the cost of fuel will trump many things, except perhaps value of time (cost of an employee etc). What is a possible plan to ensure the total cost of hydrogen, including taxes, is competitive with gasoline and diesel? Should this be ensured?

Topic #1: Hydrogen and Electricity Production and Distribution



What other questions should we be asking?



Topic #2

Grant Funding

Topic #2: Grant Funding



What are your biggest challenges when applying for funding in California? What are your ideas for improving it?

Topic #2: Grant Funding



Assuming we cannot have just one form for all grant programs, what are some other strategies we can employ?

Topic #2: Grant Funding



What are some commonalities of the various zero-emission infrastructure grant applications that we provided as examples?

Topic #2: Grant Funding



What other questions should we be asking?



Topic #3

Total Cost of Ownership of Zero Emissions Trucks

Topic #3: Total Cost of Ownership



What potential solutions do you see to address the total cost of ownership? Does your organization have any specific approaches to share?

Topic #3: Total Cost of Ownership



What are the differences in cost between zero-emission drayage trucks and zero-emission long-haul trucks?

Topic #3: Total Cost of Ownership



What leasing options does your organization plan on implementing, if applicable?

Topic #3: Total Cost of Ownership



What other questions should we be asking?



Closing Remarks



Thank you!

REFERENCE FOR TOPIC #2

**EXAMPLE FUNDING APPLICATIONS OR APPLICATION
REQUIREMENTS**

The following examples are programs that fund zero-emission infrastructure.

EXAMPLE #1

**APPLICATION FOR THE CTC's TRADE CORRIDOR
ENHANCEMENT PROGRAM**

VI. Attachments

Attachment 1. Project Nominations

Nomination Deadline

Project nominations and supporting documentation must be submitted to the Commission by **November 18, 2022**. Nominations will be treated in accordance with California Public Records Act requirements and information, subject to those requirements, may be publicly disclosed.

Metropolitan Planning Organization Letter

The Metropolitan Planning Organizations (MPOs) will be responsible for compiling project nominations from their respective agencies to the Commission. Project nominations coming from Imperial County will be considered as part of the San Diego/Border programming target, but the project nominations from Imperial County will be compiled and submitted through the Southern California Association of Governments as its Metropolitan Planning Organization. All other project nominations will be submitted directly to the Commission.

Each Metropolitan Planning Organization will submit a cover letter signed by the respective Executive Director. The submittal will include:

- A full list of all nominations received, and
- Confirm consistency, or the lack of consistency, with an adopted Regional Transportation Plan and if applicable, its Sustainable Communities Strategies and adopted regional freight plan.

This cover letter is submitted by the MPOs and is separate from the cover letters that are to be submitted with each project.

The MPO cover letter is due prior to the nomination form deadline and can be submitted via email to TCEP@catc.ca.gov.

General Nomination Form Submission Instructions

- Applications must be submitted by the deadline listed above, which is November 18, 2022.
- Applicants must submit one (1) electronic copy. Electronic copies should be sent via e-mail to TCEP@catc.ca.gov.
- Each project nomination should be limited to 35 pages, excluding information requested in appendices.
- Each project nomination must utilize the lettering convention outlined below. For example, the overview of the project, the map, and the project scope should all be part of a section in your application that has a section heading such as, "C. General

Information.” Screening criteria information should be under a section labeled something like, “D. Screening Criteria.”

A. Cover Letter

- A cover letter must be submitted with the application.
- The cover letter must be addressed to the California Transportation Commission’s Executive Director.
- The cover letter must clearly identify the nominating agency or agencies.
- Signature requirements
 - Nominations from regional agencies must include the signature of the Chief Executive Officer or other authorized officer of the agency.
 - Nominations from Caltrans must include the signature of the Director of Transportation or a person authorized by the Director to submit the nomination.
 - Jointly nominated projects must have the duly authorized signatures of all agencies.
 - Where a project is to be implemented by an agency or multiple agencies other than the nominating agency, the nomination must also include the signature(s) of the Chief Executive Officer or other authorized officer(s) of the implementing agency or agencies.

B. Fact Sheet

- A one-page or two-page fact sheet describing the project scope, cost, schedule, and benefits (outputs and outcomes), which also includes a brief narrative of how the project would impact Greenhouse Gas Emissions, how the project considers transportation equity, and how the project mitigated or avoided negative community impacts to result in better outcomes. The fact sheet should be written in “plain language” so a non-technical audience can understand it. It also must include a high-quality project picture or rendering of at least 300 Dots Per Inch (DPI), as well as a nominating agency logo. The fact sheet will be posted on the Commission’s website and therefore must meet the latest state and federal web accessibility laws. Information about [California website accessibility laws](#).

C. General Information

1. **Overview:** Include a brief, one to three paragraph, non-technical description of the project. The description should focus on why the project is a good freight project. It should include a brief project background, the project purpose, and the need for the project.
2. **Map:** A map (or maps) of the project location
3. **Priority:** Project priority (if submitting multiple nominations)
4. **Scope:** A relatively brief (no longer than two paragraphs) description of the project scope. Include a list of outputs for the project. Make sure the outputs listed here match the outputs submitted in the Project Programming Request (PPR).

5. **Independent Utility:** A project requesting construction funds must have independent utility. If the application is requesting funds for construction and proposing a project segment, then in no more than two paragraphs, explain why the project is being segmented, and why the proposed segment has independent utility.
6. **Consistency with RTP/SCS:** Confirm that the proposed nomination is consistent with the current approved Regional Transportation Plan and Sustainable Communities Strategies. This can be a single sentence stating this fact.
7. **Nominating Agency/Implementing Agency Agreement:** If the project will be implemented by an agency other than the nominator, confirm that there is or will be a written agreement in place between the project nominator and implementing agency. This can be a single sentence stating this fact.

D. Screening Criteria

1. **Eligible Projects:** Explain how the project is consistent with the projects described in Section 11 (eligible projects section) of the guidelines. To explain this, choose one or more of the types of eligible projects listed in section 11 of the guidelines and explain how the project fits under the category/categories selected. Either limit the discussion to one or two paragraphs or present the information in the form of a short table.

E. Project Delivery

1. **Delivery Method:** Specify what delivery method is being used for the project. If a delivery method other than design-bid-build is used for the project, identify the delivery method used. If the delivery method is unknown at the time of nomination, it should be reported as soon as it is known. This can be a one sentence statement, it should not be longer than a paragraph.
2. **Contracts:** If more than one contract will be needed for the same phase, note that in this section.
3. **Schedule Risks:** Either in paragraph form or in a table, list any potential schedule risks and your proposed mitigation strategies to keep the project on schedule. Examples of schedule risks include geotechnical analysis needs or concerns, complicated utility relocations, or land acquisition needs.
 - a. If the project requests allocation in the last fiscal year of the program, explain why the project will be ready to allocate on time.
4. **Rail Company Coordination:** Include a timeline for any necessary coordination with rail companies such as the Union Pacific Railroad or the Burlington Northern Santa Fe railroad. Below are examples of rail company involvement.
 - a. A construction maintenance agreement.
 - b. Permission from a rail company is required to use, make changes to, acquire, or work on their land.
 - c. A rail company must review and approve the project design.

- d. Any other kind of significant involvement.

If the project requires coordination with a rail company, include a timeline with the following information:

- e. When the project team will begin and end engagement with the rail company.
- f. Average review and approval timeframes for the rail company.
- g. Dates when the project team will secure any necessary approvals.
- h. Any other major milestones.

5. California Environmental Quality Act (CEQA)/National Environmental Policy Act Status:

- a. For projects requesting design, right-of-way, or construction funding:
 - i. A one to two paragraph description of where the applicant is in the process of securing approval for CEQA and, if necessary, NEPA.
 - ii. A one to two paragraph description of the environmental and community impacts identified in the environmental document and if applicable the proposed mitigations. You can also present this in a table.
 - iii. A link to the final environmental document/s, or the draft environmental document/s, must be included for all project segments.
 - iv. If your CEQA documents are not complete, then in one or two paragraphs, explain how you will ensure the completion of CEQA and NEPA within six months of program adoption.

F. Evaluation Criteria

Performance Metrics: The Performance Metrics form is included in these guidelines as Attachment 4. The applicant must complete the Performance Metrics form. For evaluation criteria that are also performance metrics, it is how the quantitative information is provided. Make sure the numbers from the Performance Metrics form match/align with the qualitative descriptions provided. Instructions for calculating the performance metrics can be found in the Performance Metrics Guidebook, available here: <https://catc.ca.gov/-/media/ctc-media/documents/ctc-workshops/2022/sb-1/performance-measurement-guidebook-final-draft.pdf>

Required Criteria: Each of the criteria identified in Section 18 of the guidelines must be addressed. If a criterion is not addressed, the project may not be funded in the Trade Corridor Enhancement Program. Include a separate paragraph addressing each of the criteria from section 18 of the guidelines. The required criteria from section 18 are listed below for reference.

1. Freight System Factors

- a. Throughput – Project provides for increased volume of freight traffic through capacity expansion or operational efficiency. This is also a performance metric.
- b. Velocity – Project increases the speed of freight traffic moving through the distribution system. This is also a performance metric.

- c. Reliability - Project reduces the variability and unpredictability of travel time. This is also a performance metric.

2. Transportation System Factors

- a. Safety - Project increases the safety of the public, industry workers, and traffic. This is also a performance metric.
- b. Congestion Reduction/Mitigation - Project reduces daily hours of delay on the system and improves access to freight facilities. This is also a performance metric.
- c. Key Transportation Bottleneck Relief - Project relieves key freight system bottlenecks where forecasts of freight traffic growth rates indicate infrastructure or system needs are inadequate to meet demand.
- d. Multi-Modal Strategy - Project employs or supports multi-modal strategies to increase port and transportation system throughput while reducing truck vehicle miles/hour traveled (VMT/VHT) or truck idling times.
- e. Interregional Benefits - Project links regions/corridors to serve statewide or national trade corridor needs.
- f. Advanced Technology – Project employs advanced and innovative technology and integrates transformative ideas to increase benefits for the state’s people, economy, and environment, and those that include the installation of broadband (conduit and/or fiber).
- g. Zero-Emission Infrastructure - Project supports zero-emission freight infrastructure.

3. Community Impact Factors

- a. Air Quality Impact - Project reduces local and regional emissions of diesel particulate (PM 10 and PM 2.5), carbon monoxide, nitrogen oxides, greenhouse gases, and other pollutants. This is also a performance metric. To ensure the benefits of public health, project reduces exposure to air pollutants.
- b. Economic Impact – Project stimulates local economic activity, enhances trade value, preserves or creates jobs, enhances California’s freight competitiveness, improves the economy, and when looking at the overall need, benefits and cost, the project provides more benefits than costs. This makes up two performance metrics, jobs created and the benefit cost ratio.
- c. Community Engagement – In alignment with the Commission’s Racial Equity Statement, projects will be evaluated based on their ability to demonstrate meaningful and effective public participation in decision making processes, particularly by disadvantaged or historically impacted and marginalized communities. In responding to this criterion, please refer to the *SB 1 Competitive Programs’ Transportation Equity Supplement* (included in Attachment 5).

4. Other Criteria

- a. How well the project addresses the state’s most urgent freight needs.
- b. Leveraging Funds – The leveraging and coordination of funding from other private, federal, state, local or regional sources, with consideration of those sources that are discretionary compared to those that are nondiscretionary.

- c. Project Readiness – Project readiness and reasonableness of the schedule for project implementation, including the following:
 - Progress towards achieving environmental protection requirements. If CEQA/NEPA information has already been provided in the “CEQA/NEPA” section above, simply reference that section.
 - The comprehensiveness and sufficiency of agreements with key partners that will be involved in implementing the project. For rail information, if it has already been provided in the “Rail Company Coordination” section above, simply reference that section.
- d. The commitment of multiple partners in the delivery of the project, as evidenced by joint nomination and/or joint funding of a project.
- e. Any other factors considered relevant at the time of application.

G. Other Project Information Areas

Please provide information about the following areas below. Instructions about what specifically is being requested can be found in section 19 “Other Information Areas” in the guidelines.

1. **Accessibility** – Project improves access to jobs or key destinations, improves access for specific populations, or improves transportation options.
2. **Climate Change Resilience and Adaptation** – Project identifies and includes project features or strategies to mitigate the impacts of climate change.
3. **Protection of Natural and Working Lands, and Enhancement of the Built Environment** – Does the project minimize the impact on natural and working lands (e.g., forests, rangelands, farms, urban green spaces, wetlands, and soils) or incorporate natural and green infrastructure?
4. **Public Health** – Does the project remove or alleviate conflicts between freight vehicles and other travel modes?

H. Funding and Deliverability

1. **Funding Table:** Fill out the table below for all phases of the project. This should align with the PPR submitted with the application.
 - **Cost estimates:** Costs should be escalated to the year of proposed implementation and be approved by the Chief Executive Officer or other authorized officer of the implementing agency.
 - **Required Match:** Make sure it is clear the project funding includes the required 30% funding match for each programmed component as outlined in section 6 of the guidelines. Please note that when calculating the required match, Commission staff will not count funds programmed in years prior to the first year

in which TCEP funds are requested. Also, the match is calculated separately for each phase where TCEP funds are requested.

Include a few sentences explaining why local funds can be reasonably assumed to be available.

Phase	Fiscal Year of Allocation	Amount	Funding Source	Committed or Uncommitted

2. **Total Project Cost:** Include the total project cost. You can include the total costs at the end of the table or in a separate sentence or bullet. Make sure it matches the PPR.
3. **Committed/Uncommitted Funds:** If any funds are not committed, review the requirements outlined in Section 22 of the guidelines. Explain the risk of not securing the commitment, and the plan for securing an alternate source of funding if necessary.
4. **Cost Overruns:** Describe the ability to absorb any cost overruns and deliver the proposed project with no additional funding from this program, except as noted in Section 22 of these guidelines.
5. **Contracts:** If more than one contract is needed for the same phase, and as a result two separate allocations will be needed for the same phase, note that in this section.
6. **Preconstruction Requests:** If proposing to fund only preconstruction project components, explain how future construction will be funded.
7. **Federal Grants:** Identify any discretionary federal funds that have been committed as of the application due date. Proof of the commitment should be provided in the form of a letter or public announcement issued by the authorizing federal agency.
8. **Ineligible Elements:** Identify any ineligible elements of a project and confirm that those ineligible elements will not be funded with Trade Corridor Enhancement Program funds.

I. Other

1. **Public/Private Benefits:** If the project includes significant benefits to private infrastructure or a private company, then please include the following analysis.
 - a. Include a list of public benefits and a list of private benefits of the project. If there is overlap in some benefits that's ok but please be as specific as possible.
 - b. Based on the total project cost, provide an estimate of what percent of the funds will directly benefit private infrastructure or a private company, and what percent will directly benefit the public.
 - c. Explain who will own the asset once the project is completed.
 - d. If the project results in private benefits, explain why the public benefit of the project warrants the investment of public funding and why the share of public benefit is commensurate with the share of public funding.

2. **Interagency Cooperation:** For projects on the state highway system, evidence must be provided of cooperation between the nominating agency and Caltrans. This statement only needs to be a few sentences that explain your cooperation.
3. **Bulk Coal:** Confirmation that any new terminal project will not have significant environmental impacts, as described in related environmental documents as a result of the storage, handling, or transport of coal in bulk pursuant to Government Code Section 14525.3. In evaluating each new terminal, if related environmental documents are not yet complete, the Commission shall base their review on written confirmation from the project applicant. This can be a single sentence statement.
4. **Reversible Lanes:** Confirmation that any capacity-increasing project or a major street or highway lane realignment project was considered for reversible lanes pursuant to Streets and Highways Code Section 100.15. This does not need to be longer than a few sentences.

Attachment 2. Performance Metrics Form

Trade Corridor Enhancement Program

Existing Average Annual Vehicle Volume on Project Segment						
Existing Average Annual Truck Percent on Project Segment						
Estimated Year 20 Average Annual Vehicle Volume on Project Segment with Project						
Estimated Year 20 Average Annual Truck Percent on Project Segment with Project						
Measure	Metric	Project Type	Build	Future No Build	Change	Increase/ Decrease
Congestion Reduction (Freight)	Change in Daily Vehicle Hours of Delay	All				
	Change in Daily Truck Hours of Delay	All (except rail)				
	(Optional) Person Hours of Travel Time Saved	All				
	(Optional) Daily Truck Trips Due to Mode Shift	Rail, Sea Port				
	(Optional) Daily Truck Miles Travelled Due to Mode Shift	Rail, Sea Port				
	(Optional) Other Information	All				
Throughput (Freight)	Change in Truck Volume	Highway, road, and port projects only				

	Change in Rail Volume	Rail				
	(Optional) Change in Cargo Volume	Sea port, airport				
	(Optional) Other Information	All				
System Reliability (Freight)	Truck Travel Time Reliability Index ("No Build" Only) (Optional Metric)	National and State Highway System Only				
	(Optional) Other Information	All				
Velocity (Freight)	Travel time or total cargo transport time	All				
	(Optional) Change in Average Peak Period Weekday Speed for Road Facility	Road				
	(Optional) Average Peak Period Weekday Speed for Rail Facility	Rail				
	(Optional) Other Information	All				
Air Quality	Particulate Matter (PM 10)	All				
	Particulate Matter (PM 2.5)					
	Carbon Oxide (CO ₂)					
	Volatile Organic Compounds (VOC)					
	Sulphur Oxides (SO _x)					
	Carbon Monoxide (CO)					
	Nitrogen Oxides (NO _x)					
Safety	Number of Fatalities	Road and				

	Rate of Fatalities per 100 Million VMT	Land Port				
	Number of Serious Injuries					
	Number of Serious Injuries per 100 Million VMT					
	(Optional) Number of Non-Motorized Fatalities and Non-Motorized Serious Injuries					
	(Optional) Other Information	All				
Cost Effectiveness	Cost Benefit Ratio	All				
	(Optional) Other Information	All				
Economic Development	Jobs Created	All				
	(Optional) Other Information	All				

Attachment 3. Project Programming Request

Each application must include a Project Programming Request form. The Project Programming Request must list federal, state, local, and private funding categories by project component and fiscal year. If the proposed project includes multiple project modes to be delivered under separate contracts, each project mode must have its own Project Programming Request. The scope, benefits, schedule and funding plan of the Project Programming Request must be consistent with the information in the application. The template of the Project Programming Request form may be found at: <https://dot.ca.gov/programs/financial-programming/office-of-capital-improvement-programming-ocip>

Attachment 4. State Highway System Project Impact Assessment Instructions and Form (CTC-0002)

This form is only required for local projects that are not Caltrans nominated. Applicant must complete ALL fields in Sections I and II. Write N/A if not applicable. Applicant must also provide the Attachments requested in Section IV.

Assessment Form and all attachments must be submitted to Caltrans District Contacts (contact link in Section III) no later than four (4) weeks prior to Application Due Date. Late or incomplete submissions of this form and attachments may delay applications.

1. Applying Agency
2. Name of Person submitting the nomination
3. Title
4. Phone
5. Email
6. Project Title - The title must be consistent with the nomination and all project documentation
7. Indicate the State Funding Program(s) associated with the project. Check all that apply.
8. Percentage of project area within State Right of Way: $(\text{Area within State Right of Way} \div \text{Total project area}) \times 100$
9. Total construction cost of physical project elements within State Right of Way: Provide a separate estimate for the total construction cost (capital and support costs) of the project for only those physical elements and/or portions of elements that are on or within State Right of Way. This includes project elements within State airspace. Please refer to the completed estimates form or figures included in the project application.
10. Indicate the anticipated environmental document that will be required for California Environmental Quality Act and National Environmental Policy Act (ex. Negative Declaration, EIR/ EIS, etc.) Indicate N/A if a National Environmental Policy Act document is not required.
11. Fully describe the scope of work to be performed within State Highway Right of Way. This includes all new or modifications to any physical assets within State Right of Way.
12. Follow the steps and linked resources to determine induced Vehicle Miles of Travel (VMT) on the State Highway System (SHS) and applicable calculations. Enter text inputs on 4, 5, or 6 as applicable. Note: Active Transportation Program (ATP) projects may not induce VMT per the ATP Guidelines. ATP applicants check number 1 and proceed to Section 13.
13. Review the linked flowchart and resources for appropriate level of involvement. Check the applicable items in the checklist to determine appropriate process. Check the processes that apply. Caltrans will review and retains the right to make a final determination.

Caltrans may include attachments after review identifying expected maintenance obligations and/or project risks.

EXAMPLE #2

**APPLICATION CHECKLIST FOR CEC'S ENERGIIZE
PROGRAM**

Appendix J – EnergIIZE Application Document Checklist

Application Process	LANE	DOCUMENTATION REQUIRED FOR PROOF
Proof Required to Participate in Lanes	EV Fast Track	Electric vehicle purchase order or proof of ownership
	EV Jump Start	Vehicle Commitment Agreement
		Jump Start Certification Form
	Public Charging	Location supports corridor charging
		Demonstrates business case for MD/HD charging energy and throughput
	Hydrogen	Completion of Critical Milestones
Qualitative questions		
1. Submit Application	All Lanes	EnergIIZE Application, including equipment manifest
		Answers to qualitative questions (for projects requesting greater than \$150,000 in incentives)
		Site Verification Form- to authorize builds on leased land, with proof of property ownership and/or authorization of installation work by the property owner. If new or upgraded equipment is provided by the utility, then proof of Easement is required.
		Confirmation from the local utility that the project site is adequately prepared to receive the necessary energy load.
		Signed Terms and Conditions
		Jump Start Certification Form- proving your status as one or more of those entities described under the EV Jump Start funding lane, if applicable
	EV Fast Track	Vehicle PO or proof of ownership
Hydrogen	Proof of completion of Critical Milestone 1	
2. Provide Supporting Documents	All Lanes	Cost Share Form- with total project cost estimate, disclosure of other public funding to be used, and share Applicant intends to pay
		Preliminary Site Plan
		General contractor: proof of license, insurance, EVITP for EVSE's only
		Milestone Payment Schedule and Request Form
		Copy of Purchase Order for EVSE's or hydrogen equipment
	Hydrogen	Copy of the preliminary hydrogen safety plan, executed copy of the Hydrogen Project Attestation of Codes and Standards, and proof of completion of Critical Milestone 2
	EV Jump Start	Signed Vehicle Commitment Agreement
3. Plan Project	All Lanes	Copy of the building permit
		California Environmental Qualify Assessment Filing (CEQA)
		Start construction: Date, time, pictures
	Hydrogen	Copy of final hydrogen safety plan and proof of completion of Critical Milestone 3.
4. Initiate Construction	All Lanes	Copy of Signed inspections sheet and closed building permit
		Pictures showing: Installed EVSEs; switch gear and meter mains; transformers; ADA parking with proper markings, signs, placards with path of travel; ingress and egress properly marked (signs per HB 130)
	Hydrogen	Proof of completion of Critical Milestone 4



5. Commission Project	All Lanes	Copy of Third-party network provider communications contract
		Verification of Refueling/Charging
		For EVSE's: RSA certification of level 2 EVSE completed (where necessary)
		Copies of all invoices are submitted

Aug. 2022



EXAMPLE #3

APPLICATION FOR CARB'S CARL MOYER PROGRAM

the review process, thoroughly discuss any findings and recommendations with the air district before and during the exit interview, and provide the air district an opportunity to formally respond to the Incentive Program Review report.

- (C) To ensure objectivity and predictability, ARB will base its findings and recommendations on State law, applicable guidelines and Mail-Outs, grant agreements, email communications between ARB and the air district, the air district's Policies and Procedures Manual, case-by-case determinations, and the air district's local requirements.
- (D) All Incentive Program Review reports, air district responses, and related documents shall be made available to the public via posting on ARB's Moyer Program website.
- (E) ARB will conduct follow-up activities to ensure any deficiencies remaining following review are promptly and effectively mitigated. ARB will offer its assistance to air districts working to correct deficiencies.

5. Air District Responsibilities. Air district staff and management will participate in entrance and exit interviews, support collaborative review and open communication with ARB staff, ensure that program files and other requested information are available to reviewing staff of ARB and the Department of Finance, work to fully and promptly mitigate deficiencies identified during the review, work to resolve any disagreements, and request assistance from ARB as necessary.

6. DMV Fee Project Evaluation. AB 923 \$2 MV Fee projects are subject to Incentive Program Review or evaluation as follows:

- (A) A Moyer Program match project funded with the AB 923 \$2 MV Fees will be subject to the same review and oversight requirements and protocols as other Moyer Program match projects.
- (B) A non-match project funded with the AB 923 \$2 MV Fee may be evaluated by ARB in conjunction with an Incentive Program Review. Evaluation of these projects will be limited to project eligibility. Any irregularities regarding non-match AB 923 \$2 MV Fee project eligibility will be reported separately from other Incentive Program Review findings.

S. Requirements for Project Applications

- 1. Data Required for CARL.** Project applications must include the information needed for calculation of project cost-effectiveness in the CARL database.
- 2. Existing Engine Usage.** Project applications must include documentation of existing engine usage, such as miles traveled, hours operated, or fuel consumed per year, for 24 months or as specified in these guidelines by source category.

This information will be used to evaluate project cost-effectiveness and the maximum grant award amount.

- 3. Active Duty Military Applicants.** If an applicant has been on active military duty at any time during the previous 24 months, documentation prior to deployment and covering the same length of time as the deployment period may be used to meet the title, registration, usage, and operation in California requirements as applicable for each source category. The applicant must submit a copy of DD Form 214, Certificate of Release or Discharge from Active Duty to verify military service during the deployment period.
- 4. Third Party Signature.** Applications must include a signature and date section for third parties. A third party may complete an application or part of an application on an owner's behalf if the vehicle, engine, or equipment owner signs and dates the application.
- 5. Applicant Certification.** Project applications must include language informing the applicant that by signing and submitting the application, the applicant certifies under penalty of perjury that the information in the application is accurate and true. In addition, the application must include the following statements that the applicant or the applicant's designee must certify as accurate and true:
 - (A) A disclosure statement consistent with Section L.6. of this chapter, specifying whether the applicant has submitted an application for incentive funds to any other entity or program for the same equipment (for example, repowering of the same engine). The applicant must disclose to whom other applications were submitted, whether funds have been awarded or may be awarded, and the amount or potential amount of other funding.
 - (B) A regulatory compliance statement certifying that the applicant is currently in compliance with all federal, State, and local air quality rules and regulations at time of application submittal, and is not aware of any outstanding or pending enforcement actions.
- 6. Applicant Non-Disclosure.** An applicant who is found to have applied for or received incentive funds from another entity or program for the same project without disclosing that information as required by these Guidelines shall be disqualified from funding for that project from all sources within the control of an air district or ARB. The air district or ARB may also seek civil penalties for such non-disclosure.
- 7. Subsequent Applications.** An applicant may re-apply for project funding if a previous application for the same project has been rejected by the air district and is no longer being considered for funding.

T. Application Evaluation and Project Selection

- 1. Review for Completeness.** Air districts must review all applications for completeness upon receipt, and notify an applicant within 30 working days of receipt if the application is not complete (H&SC § 44288(a)). The air district must make every effort to clearly state to the applicant what is required to make the application complete. The application and all correspondence with the applicant should be kept in the applicant's project file. Additionally, the record of each project's rating and ranking as applicable, receipt date, and other project selection criteria must be maintained with the project file.
- 2. Credibility.** Air districts are responsible for determining that project applications are credible, made in good faith, and in compliance with the Moyer Program and its objectives.
- 3. Eligibility.** Air districts must ensure that the emission reductions provided by selected projects are eligible and surplus to adopted regulations and other legal requirements. This should include checking to ensure the project meets the minimum requirements in the appropriate source category chapter, including:
 - (A) Documentation of historical vehicle, equipment, or engine usage;
 - (B) Documentation of project costs;
 - (C) Engine or retrofit device Executive Orders, if applicable;
 - (D) Proof of a vehicle compliance check as needed for on-road projects;
 - (E) Other documentation identified in the source category chapter.
- 4. Application Tracking.** Air districts must have a system for tracking applications. CARL may be used to satisfy this requirement if an air district enters the data from all applications received into this database, whether the application is provided funding or not. Air districts not using CARL will track the information needed to populate required CARL data fields. A tracking system is not required for air districts receiving under one-half percent of the current fiscal year total Moyer Program Funds, or \$450,000, whichever is less.
- 5. Project Selection.** After reviewing applications for project eligibility, the air district must follow its Policies and Procedures Manual in selecting projects to fund. Projects approved for funding must meet all applicable requirements of these guidelines.
- 6. Communities with Most Significant Exposure.** Air districts with a population of one million or more residents must select projects from their applicant pools in a way that ensures that 50 percent or more of their Moyer Program funds are expended to reduce air pollution in communities with the most significant exposure to air pollution, including communities of minority and low-income populations (H&SC § 43023.5). Air districts may track this on a cumulative basis.
- 7. Project Evaluation.** An air district must evaluate projects to ensure each project selected for funding meets the emission reduction and cost-effectiveness

requirements of the Moyer Program as applicable. Projects may not be funded when CARL indicates these requirements are not met. In such cases, an air district representative believing a project should qualify may contact his or her ARB liaison to further evaluate project eligibility.

- 8. Recordkeeping.** The air district must maintain a file for each project selected for funding. Files may be retained in an electronic format if complete and easily accessible. Unless otherwise specified by source category or in Section K.8., project files must be retained three years following the end of the contract term. In the event final payment has not been issued prior to the end of the contract term, the three-year clock is re-started upon final payment. Applications for unfunded projects must be kept a minimum of two years following the solicitation period, or two years from receipt if there is not a specified solicitation period.
- 9. Subsequent Application and Double-Counting.** Moyer Program participants that received funding and are still under contract may not apply for funding for the same project from the Moyer Program (including a Voucher Incentive Program), from the Proposition 1B Goods Movement Emission Reduction Program, or any other program.
 - (A) If an air district chooses to amend a contract to reduce the term, the amended project must be cost-effective during the reduced contract term, based on the cost-effectiveness values and limit that applied when the original contract was executed. If an air district agrees to accept a prorated repayment of the Moyer Program grant, the repayment and amended contract execution must both occur prior to the execution of any new contract for funding.
 - (B) Emissions reductions from previously funded projects must not be included as emissions benefits of any subsequent project for the Moyer Program (including a Voucher Incentive Program) or the Proposition 1B Goods Movement Emission Reduction Program.

U. Case-by-Case Determination Process

- 1. Limitations.** ARB Moyer Program staff may approve on a case-by-case basis a project that varies from specific requirements of these Guidelines only if such approval will not adversely affect achievement of surplus, quantifiable, enforceable and permanent emission reductions. Case-by-case approvals also may not result in an exceedance of the applicable cost-effectiveness limit, or reduce program transparency, or cause a violation of law or regulation. Air districts are required to request a case-by-case determination even if they believe a project is similar to previously-approved case-by-case projects.
- 2. Procedure.** An air district may request ARB review of the project for a case-by-case determination using the procedure below. After receipt of all

**For Reference Only: Selected Pages from Total
Cost of Ownership Document Referenced in
California Air Resources Board Standardized
Regulatory Impact Assessment for the Advanced
Clean Fleets Regulation**

Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains

Energy Systems Division

EXECUTIVE SUMMARY

In order to accurately compare the costs of two vehicles, the total cost of ownership (TCO) should consist of all costs related to both purchasing and operating the vehicle. This TCO analysis builds on previous work to provide a comprehensive perspective of all relevant vehicle costs of ownership. In this report, we present what we believe to be the most comprehensive explicit financial analysis of the costs that will be incurred by a vehicle owner. This study considers vehicle cost and depreciation, financing, fuel costs, insurance costs, maintenance and repair costs, taxes and fees, and other operational costs to formulate a holistic total cost of ownership and operation of multiple different vehicles. For each of these cost parameters that together constitute a comprehensive TCO, extensive literature review and data analysis were performed to find representative values in order to build a holistic TCO for vehicles of all size classes. The light- and heavy-duty vehicles selected for analysis in this report are representative of those that are on the road today and expected to be available in the future. Table ES-1 summarizes the main parameters in this study, including the cost components which comprise TCO, the sizes and vocations of vehicles which are analyzed, the powertrains of these vehicles, and the model year for analysis of both current and future vehicles.

TABLE ES-1 Study scope: cost components and other key parameters used in this study

Cost Components	Sizes and Vocations	Powertrains
Purchase Cost	Compact Sedan	Internal Combustion Engine
Depreciation	Midsize Sedan	Hybrid Electric Vehicle
Financing	Small Sport Utility Vehicle	Plug-in Hybrid Electric Vehicle
Fuel	Large Sport Utility Vehicle	Fuel Cell Electric Vehicle
Insurance	Pickup Truck	Battery Electric Vehicle
Maintenance	Class 4 Delivery	
Repair	Class 6 Delivery	Timeframe
Taxes	Class 8 Bus	2020
Registration Fees	Class 8 Refuse	2025
Tolls and Parking	Class 8 Vocational	2030
Payload Capacity	Class 8 Tractor – Day Cab	2035
Labor	Class 8 Tractor – Sleeper Cab	2050

Previous analyses of TCO, particularly those dealing with alternative fuel vehicles (AFVs), have often focused on the purchase cost and the fuel cost. While these are two of the most important factors making up the cost of the vehicle, we find sizeable variations in other operational costs across powertrains, size classes, and usage parameters. We use vehicles modeled in Autonomie to estimate vehicle costs and fuel economy along with fuel price projections from the Energy Information Administration (EIA), and focus on developing internally consistent estimates for other relevant cost parameters. Important additive analyses in

this study include systematic analysis of vehicle depreciation, in-depth examination of insurance premium costs, comprehensive maintenance and repair estimates, analysis of all relevant taxes and fees, and considerations of specific costs applicable to commercial vehicles. This study, which considers these additional cost components, provides a more holistic and comprehensive perspective of TCO for a wider range of vehicle sizes, types, and vocations than have previously been analyzed.

TCO can be presented in aggregate terms over the entire span of the analysis timeframe, on an annualized basis, or on a per-mile basis as a levelized cost of driving (LCOD). Figure ES-1 shows the discounted lifetime costs of owning and operating two representative vehicles: a small sport utility vehicle (SUV) with a gasoline-fueled internal combustion engine (ICE) for 15 years and a heavy-duty battery electric truck (BEV) for 10 years in model year (MY) 2025. Many of our cost components, including vehicle cost and depreciation, financing, taxes, insurance, and repair, scale with manufacturer suggested retail price (MSRP). As such, all of these cost components will continue to decrease in the future as retail prices for AFVs are projected to decrease, contributing to significantly more competitive TCOs.

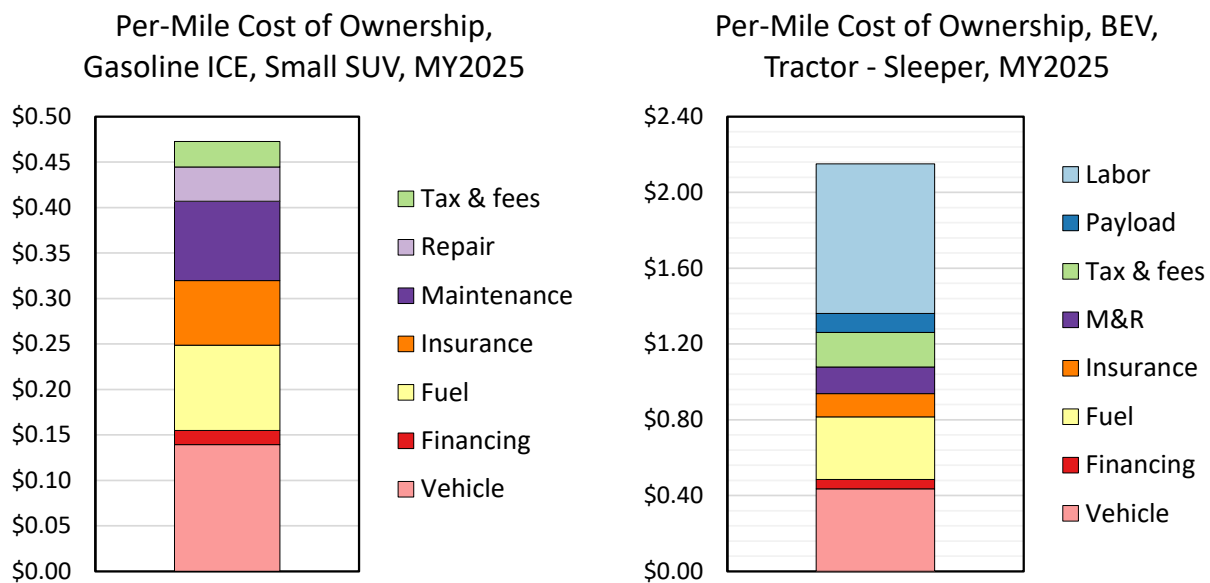


FIGURE ES-1 Levelized cost of ownership of a model year 2025, small ICE SUV (left), and a model year 2025, class 8 sleeper cab BEV (right)

To populate the data for these graphics, we undertook a thorough literature exploration on each of the cost components listed in Table ES-1. The following bullet points summarize our prior knowledge for the major additive cost components in our analysis as well as the new review, analysis and findings of our study which identify and fill what were previously gaps in our understanding of TCO, for both light-duty vehicles (LDV) and medium- and heavy-duty vehicles (MHDV) as well.

Depreciation

- New analysis: Systematic analysis of depreciation by powertrain (LDVs), development of multi-variable HDV depreciation model.
- Key findings: Cars depreciate faster than light trucks. MY13-16 electric vehicles have a greater depreciation rate than newer PEVs.

Insurance

- New analysis: In-depth analysis of liability, comprehensive and collision insurance costs for LDVs by powertrain for selected size classes, development of simple MHDV insurance cost model from several sources for a range of vocations.
- Key findings: LDV insurance costs show comparable costs for different powertrains, lower costs for larger size classes. MHDV insurance costs vary significantly by vocation.

Maintenance and Repair (M&R)

- New analysis: Systematic analysis of LDV maintenance and repair costs: maintenance schedule for LDVs by powertrain for selected size classes, model for LDV repair costs by powertrain for selected size classes. Developed estimates for MHDV M&R costs.
- Key findings: Electric and electrified powertrains have lower maintenance and repair costs than ICE powertrains for all vehicle sizes, relative to vehicle price. MHDV M&R costs depend heavily on vocation and duty cycle.

Taxes, fees, parking, tolls, etc.

- New analysis: Development of consistent costs for both LDVs and MHDVs by size class and powertrain, covering a comprehensive range of relevant taxes and fee-related costs.
- Key findings: LDV taxes and fees are comparable across powertrain types and size classes; marginally higher registration fees for AFVs. MHDV costs depend on the vocation, weight rating, and state.

Costs unique to commercial vehicles

- New analysis: Models developed to estimate labor costs of BEV charging and heavy-duty payload capacity costs.
- Key findings: Many vehicles would be affected by additional battery weight, reducing the available payload capacity, and this cost can be substantial. BEV charging can be time-consuming; labor rates can cause this cost to dominate TCO. Auxiliary Power Units to minimize idling are cost effective ways to minimize fuel consumption.

Financial analysis

- New analysis: Examination of discount rates, inflation rates, and loan terms.
- Key findings: Real loan terms of 4% for 5.25 years are appropriate for analysis along with a 1.2% discount rate for households, 3% for businesses.

Our study builds on previous work to provide a more comprehensive analysis of depreciation trends based on various vehicle attributes using resale values for a larger number of makes and models than previously investigated. We analyzed residual value of 98 vehicle models across a variety of powertrain types, size classes, and other characteristics for MYs 2013–2019 to derive a systematic model of LDV depreciation trends based on key

characteristics of the vehicle. We also performed regression modeling on MHDV used vehicle listings to derive a model of MHDV depreciation as a function of vehicle type, age, and mileage driven. Figure ES-2a shows these trends by powertrain type for LDV, indicating that both PHEVs and BEVs maintain their value better than conventional counterparts in recent years, but depreciate more quickly when considering all seven MYs. Figure ES-2b shows a sample class 8 sleeper cab depreciation for three mileage cases: default, low, and high.

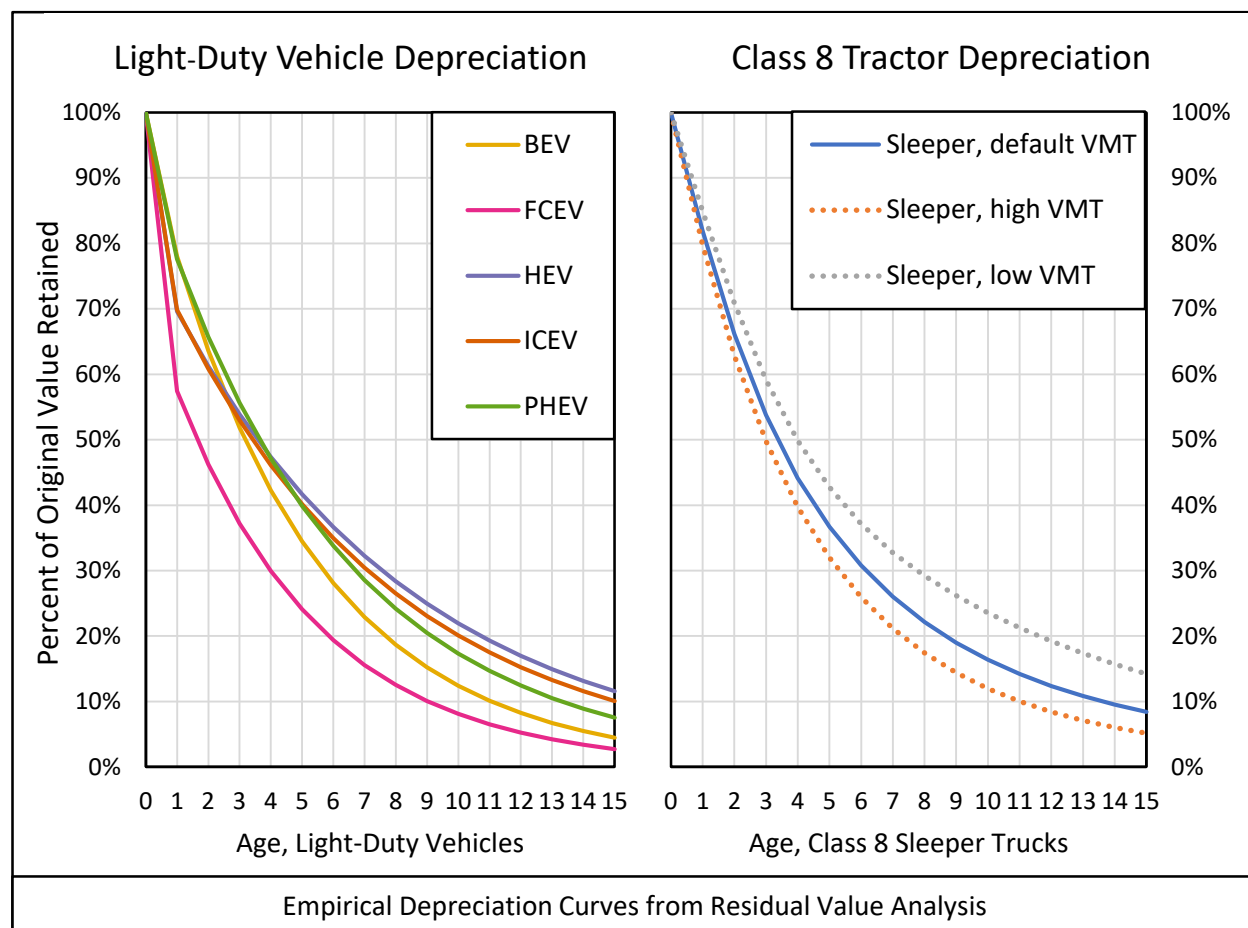


FIGURE ES-2 Depreciation trends by powertrain and size class (Car, Light truck)

Prior knowledge on insurance-related costs was limited to quotes for LDVs and some information for MHDVs. In this study, we provide a holistic analysis of insurance premiums for a wide variety of vehicles ranging in powertrain type, size class, and other vehicle characteristics. We find that the national average liability coverage premium is \$600 annually for all powertrain types and size classes. However, we also analyze differences in comprehensive and collision coverage premiums across these vehicle characteristics. As shown in Figure ES-3, we find small differences by powertrain type, but do find systematic differences in insurance premium costs by size class. For most MHDV, we use average insurance costs from Utilimarc. For tractor trailers,

we supplement average liability insurance costs from ATRI with information about physical damage insurance which exhibit differences by vehicle residual value (and thus powertrain).

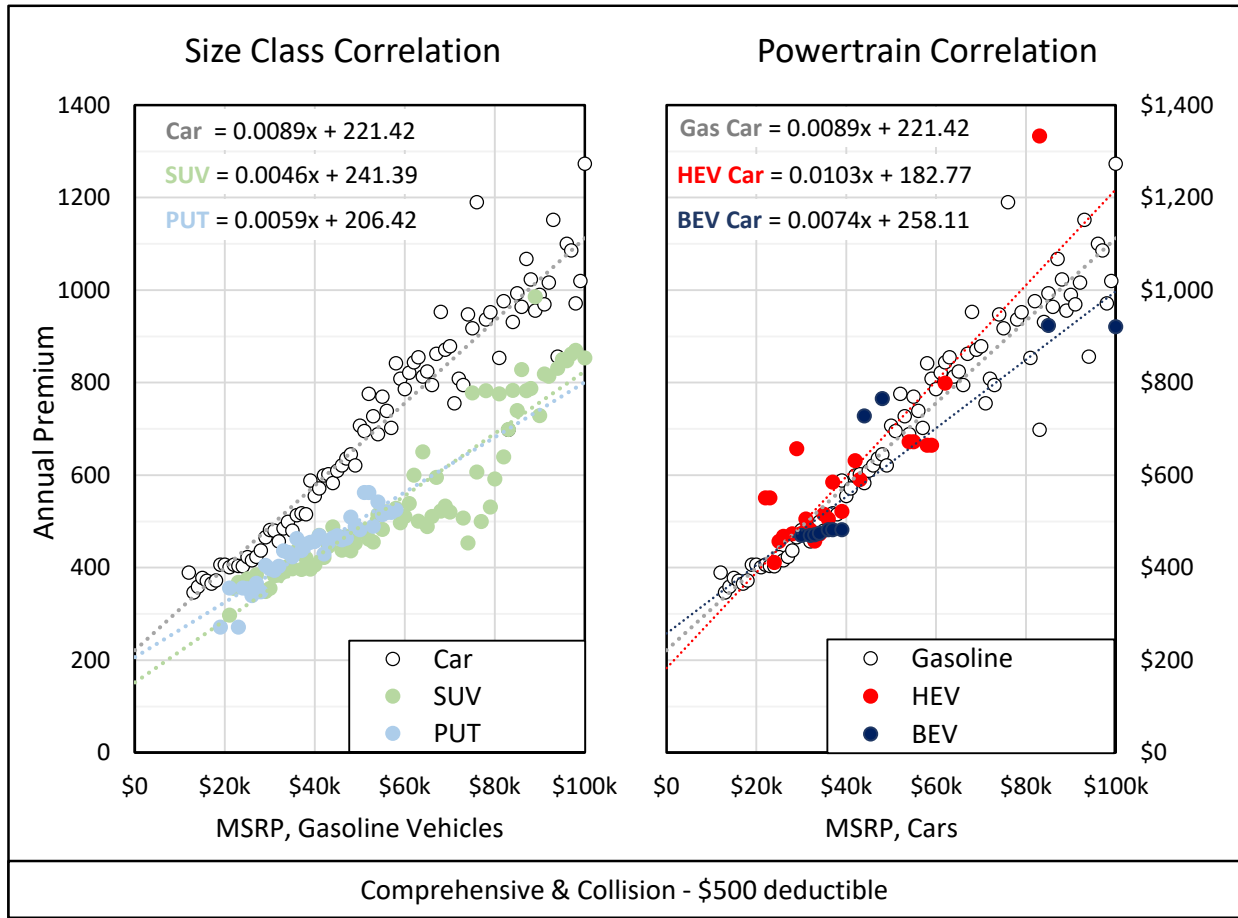


FIGURE ES-3 Annual premium for comprehensive and collision insurance by size class and by powertrain

Previous TCO studies largely omitted consideration of maintenance and repair (M&R) costs or used estimates which were assumption-based. Our TCO also includes a comprehensive analysis of M&R cost data for both LDVs and MHDVs. In addition to reviewing a wide variety of literature on combined M&R costs, we construct a generalized maintenance service schedule for each of the powertrain types. Many services have different schedules for the different powertrains (14 of the 24 in Figure ES-4, indicated by asterisks), as advanced powertrains can either extend service intervals (e.g. spark plugs for HEVs and PHEVs) or eliminate the service (e.g. oil changes for BEVs). We find that AFVs, especially BEVs, systematically have lower maintenance costs than ICEVs, as illustrated by Figure ES-4.

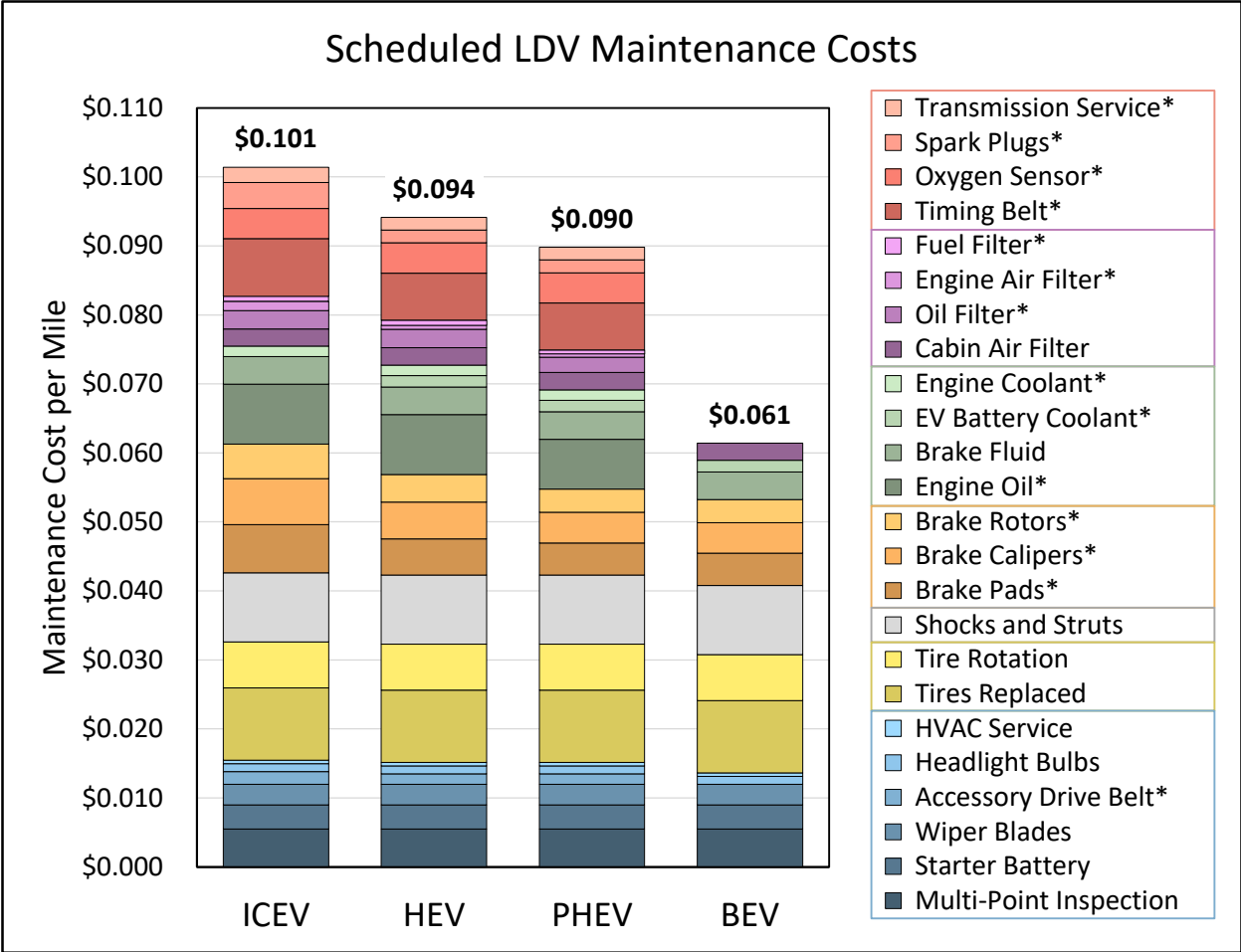


FIGURE ES-4 Per-mile maintenance costs by powertrain
 (*Service intervals that vary by powertrain)

Our analysis also included in-depth examination and modeling of repair cost data for real-world vehicles for a variety of powertrain types and size classes. We find that repair cost is an increasing exponential function of MSRP and varies significantly by vehicle characteristics; scaling factors for the powertrain type and size class of the vehicle of interest are shown in Table ES-2. The percent in each cell indicates the ratio of the repair costs for a vehicle with the given size class and powertrain to the repair costs of an ICE car with the same MSRP. Larger vehicles and AFVs both systematically tend to have lower repair costs as a percentage of MSRP. For MHDV, no size class dependence was found, but a difference in M&R costs by powertrain was observed, shown in the final row of Table ES-2.

TABLE ES-2 Repair cost scaling factors by powertrain and size class, relative to ICE car or MHDV truck with same MSRP

LDV	ICEV	HEV	PHEV	BEV / FCEV
Car	100%	89%	86%	67%
SUV	91%	81%	78%	61%
Pickup	70%	62%	60%	47%
MHDV	100%	87%	83%	60%

While information was previously available on taxes, fees, and other miscellaneous costs such as parking, tolls, etc., prior TCO work did not consistently synthesize or include these data. We analyzed the most important tax- and fee-related expenses for different powertrains, size classes, and states of purchase and registration. We find little variation in taxes and fees across different powertrain types, though find that this cost component is not insignificant in the TCO.

Prior TCO work has largely focused on LDVs, leaving a lack of thorough analysis of TCO for MHDVs. In addition to collecting and analyzing the available data for MHDVs for each of the above components, we also examine several cost components specific to these commercial vehicles that are important to a comprehensive analysis of MHDV TCO. We developed models to quantify the value of payload capacity loss resulting from heavy batteries, which can increase total TCO by over 10% for large batteries. We also explore labor costs, and particularly labor costs incurred during BEV charging. If vehicle fueling qualifies as working, the driver could spend more time charging than driving, causing the TCO for BEVs to increase dramatically.

The above results demonstrate the most important new knowledge in each of the additive cost components of our comprehensive and holistic TCO. We then aggregate each of the cost components in Table ES-1 to calculate a lifetime TCO for comparison across vehicles of different types and attributes. Figure ES-5 shows TCO results from this study comparing the LCOD of six different powertrains for a small SUV in 2025, modeled using Autonomie. Based on the assumptions chosen, the hybrid electric vehicle (HEV) has the lowest cost, followed by the conventional gasoline-fueled spark-ignition internal combustion engine (ICE-SI). The fuel cell electric vehicle (FCEV), the diesel-fueled compression-ignition internal combustion engine (ICE-CI) vehicle, and the plug-in hybrid electric vehicle (PHEV) have similar costs, while the BEV is the most expensive. The lower operating cost (especially fuel and maintenance) is not sufficient to offset the higher incremental cost of purchasing the BEV. For the non-combustion vehicles, the cost of ownership is high due to batteries (for plug-in electric vehicles) or the cost of hydrogen fuel for fuel cell electric vehicles (FCEV).

Avg. 15-year per-Mile Cost of Driving - 2025, Small SUV

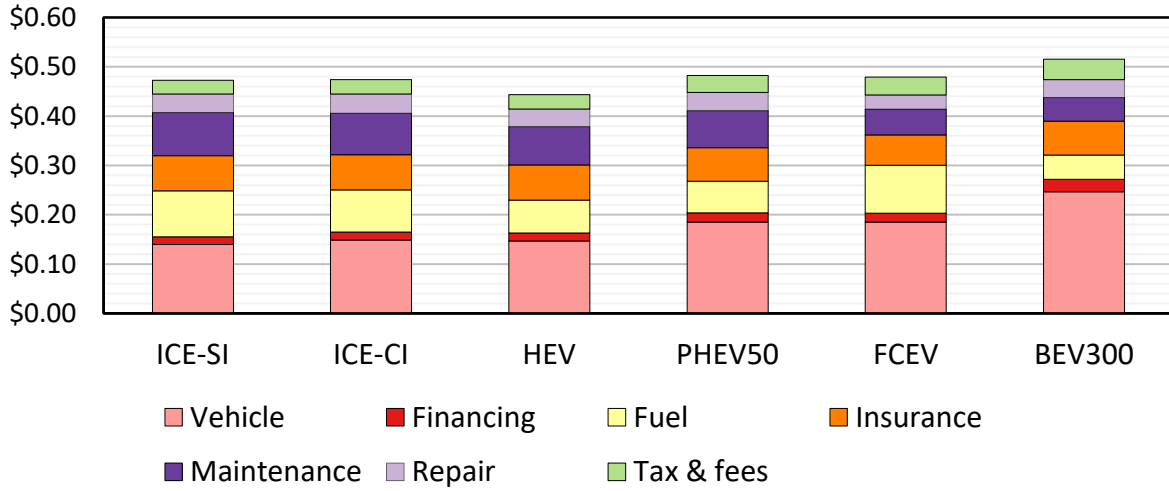
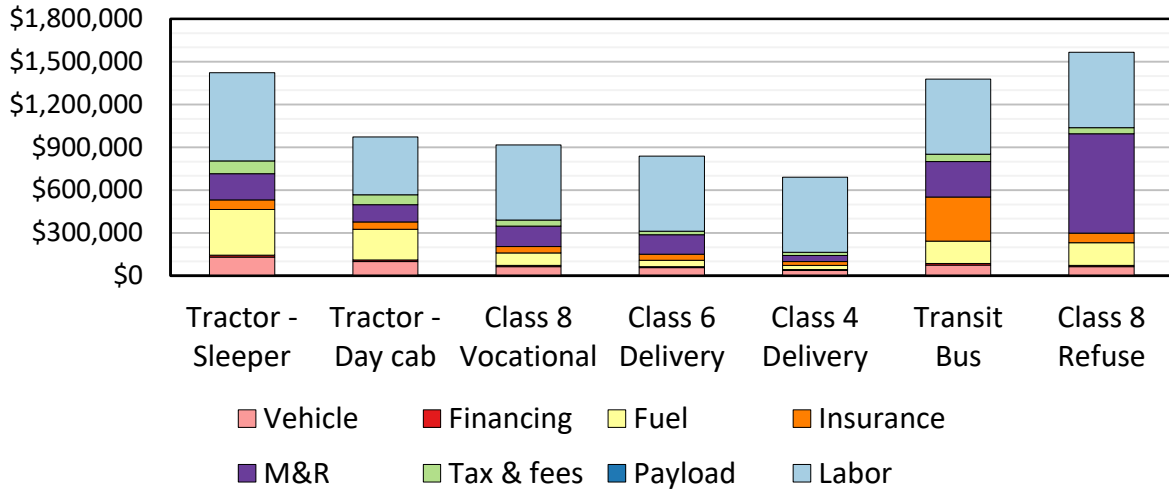


FIGURE ES-5 LCOD across powertrains for light-duty SUV, MY2025

In the case of MHDV, Figure ES-6 shows how TCO can be drastically different depending on the vocation. Typical 10-year TCOs are presented for conventional diesel ICE vehicles of seven different heavy-duty applications, ranging from a medium-size delivery truck to a long-haul tractor trailer. In this case, the class 8 sleeper cab has one of the highest lifetime costs, due to its high mileage, but has the lowest per-mile costs. On a per-mile basis, class 8 day cabs have the second-lowest TCO. TCO for medium-duty delivery trucks are the lowest on a lifetime basis, due to the reduced lifetime driving mileage relative to the other vehicles. However, they have one of the highest costs on a per-mile basis. Excluding labor costs, the class 4 delivery has a comparable TCO to the day cab. Likewise, on a total cost basis, vocational trucks are both comparatively low, but on a per-mile basis, this is one of the most expensive segments, owing to low annual mileage. Due to high M&R costs and comparatively low annual mileage, refuse trucks have higher operating cost than other vehicles. For all of these vehicles, the cost of operating the vehicle is heavily weighted by the labor of the driver, followed by the fuel costs.

Total 10-year Cost of Driving - 2025, Diesel Trucks



Average 10-year per-Mile Cost of Driving - 2025, Diesel Trucks

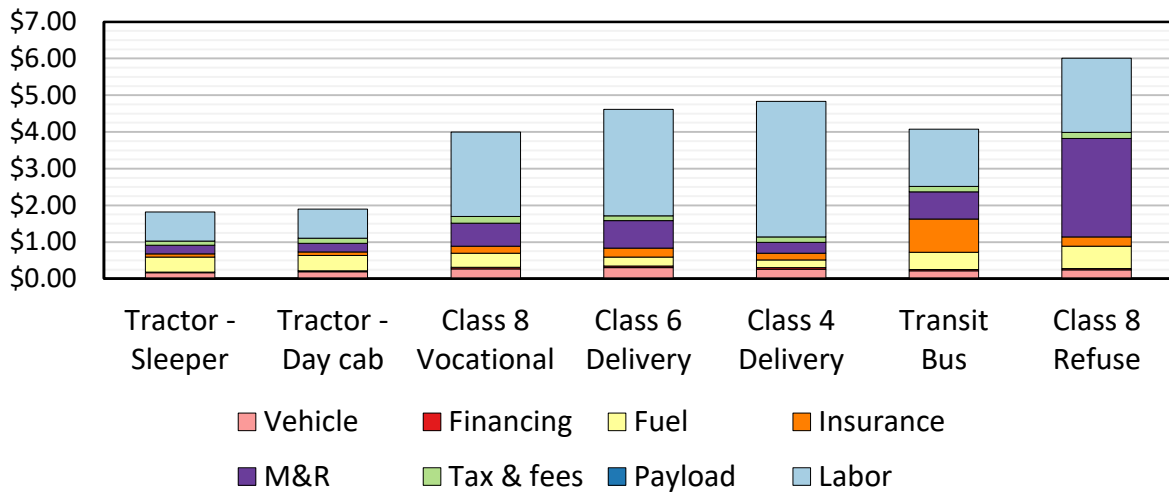


FIGURE ES-6 TCO and LCOE across MHDV vocations, MY2025

Figure ES-7 shows how the cost of vehicle ownership varies throughout a vehicle's lifetime for a typical diesel-fueled class 8 sleeper cab and for a small SUV fueled by gasoline. In the first year, ownership costs for each vehicle are at their highest due to vehicle depreciation and the cost of registering the vehicle. Vehicle costs gradually decrease as the vehicle loses residual value, while operating costs of M&R grow sharply as the vehicle ages. Insurance costs decline modestly on a per-mile basis due to the decreased residual value later in the analysis window. For the light-duty vehicle, ownership costs are mostly steady, gradually rising late in the vehicle's life due to increased maintenance and repair while vehicle depreciation diminishes.

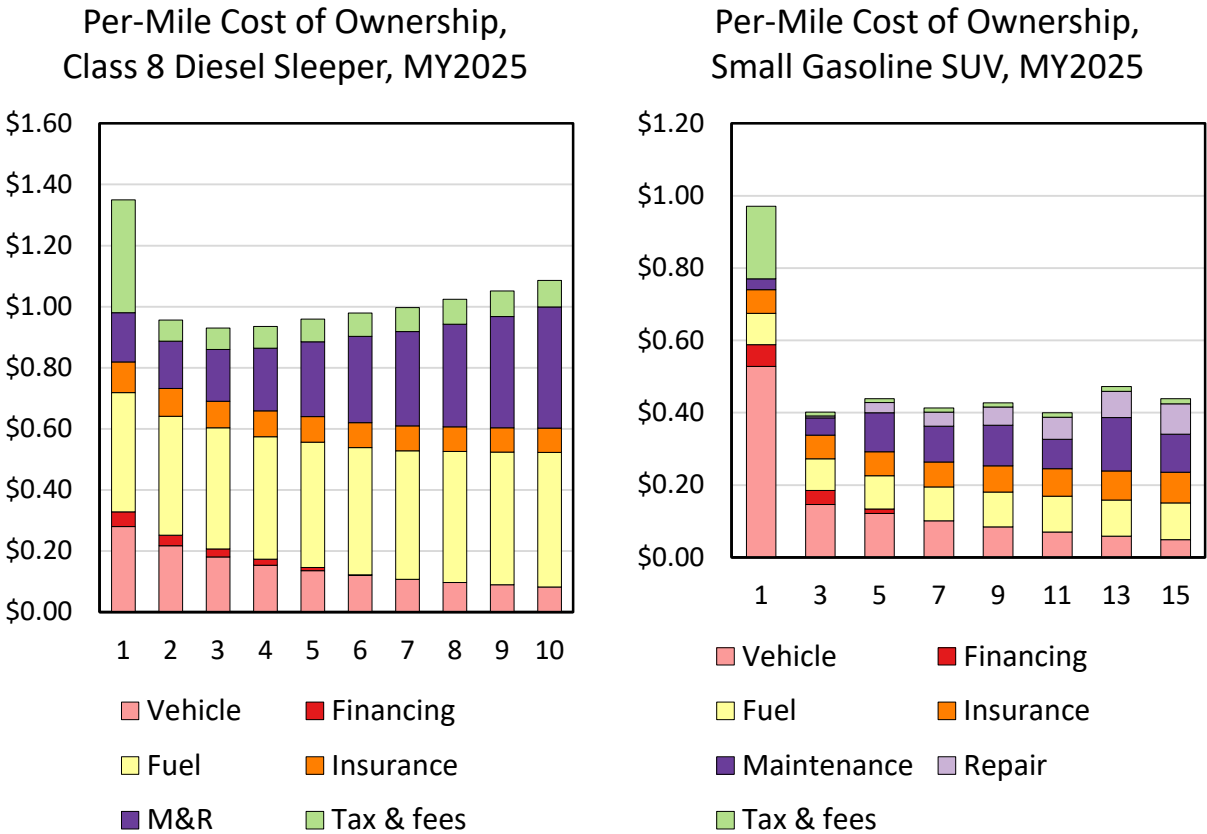


FIGURE ES-7 TCO across vehicle lifetime for class 8 diesel truck and gasoline SUV

Figure ES-8 shows how TCO is forecast to change over time and by powertrain. This figure shows the modeled reduction in TCO for the small SUV and the class 8 day cab tractor for different powertrains from 2020 through 2050 as vehicle technology improves, using modeling results from Autonomie. While the HEV begins as the lowest cost powertrain for small SUV, FCEV are forecast to reach cost parity by 2030 when hydrogen prices reach \$5/kg while BEV reaches cost parity by 2035 at a battery cost of \$98 per usable kWh of capacity, with these two technologies being the lowest cost in 2050. For the class 8 day cab tractor, the HEV and ICEV begin as the lowest cost powertrains, and the BEV250 reduces in cost from the most expensive to the least expensive by 2030. Due to the comparatively high cost of hydrogen in this analysis, the FCEV never reaches cost parity in this modeling. Cost modeling for the class 8 sleeper cab shows the same trends as the day cab, except that the BEV becomes the cheapest option by 2035. Cost modeling for the class 4 delivery truck finds the 150-mile BEV the least cost option in 2025, while the conventional diesel ICEV is the most expensive powertrain by 2030.

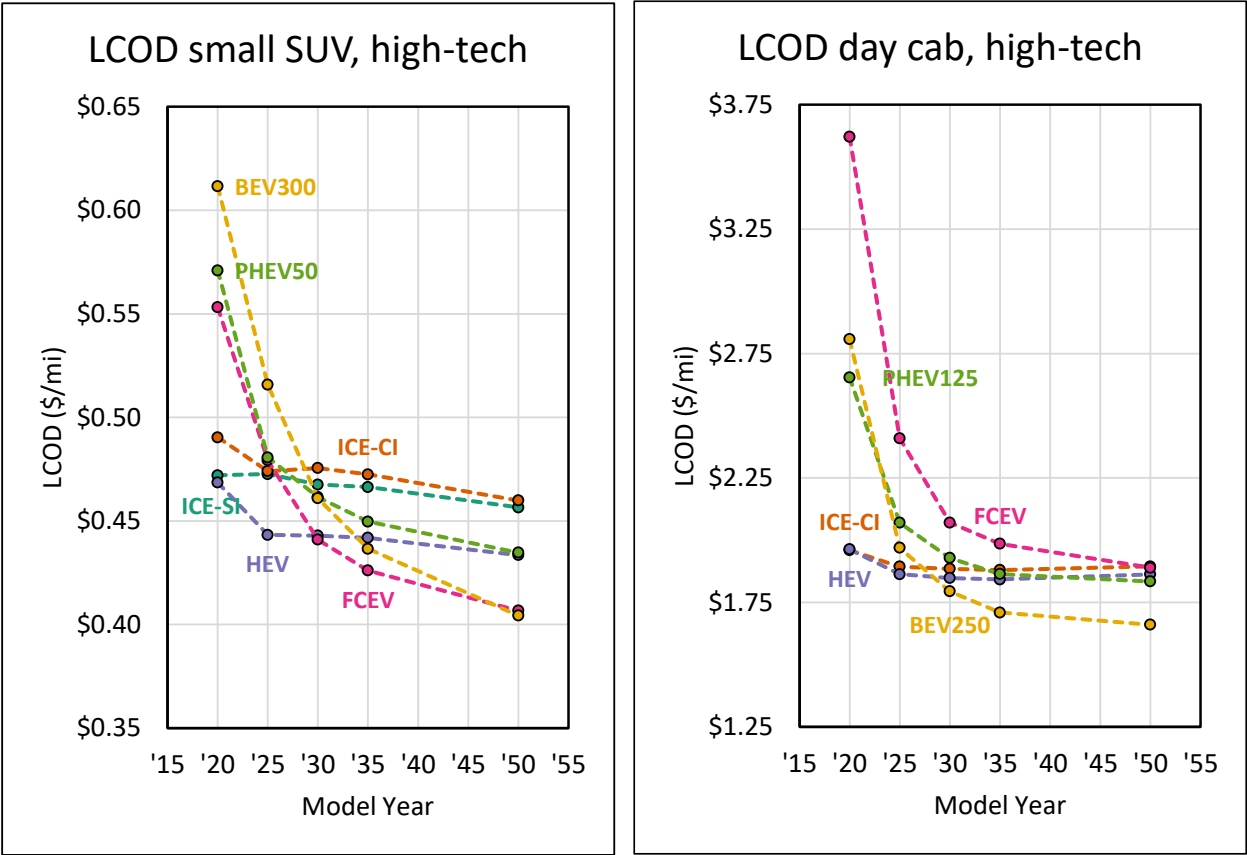


FIGURE ES-8 TCO for small SUV and class 8 day cab from MY2020 to MY2050

These results summarize some of the broad range of analyses that are presented in the body of this report. In many cases, the highest costs are for the vehicle and the fuel, but this is not always true. We find that insurance and M&R both play an important role in TCO and contribute toward differences between powertrains. In the case of MHDVs, payload capacity costs and especially labor costs both affect TCO and contribute to key differences between the powertrain types. In both cases, while taxes and fees are small contributors to TCO, they nonetheless are important to consider.

Given the breadth of cost elements presented in this report, we believe that these results can be broadly to fill gaps in analyses by other researchers. Our single-vehicle-focused analysis can be used within segmentation-type analyses which aim to identify market opportunities for specific technologies and in market adoption analyses which estimate future sales shares of different vehicle technologies.