



**Welcome!**

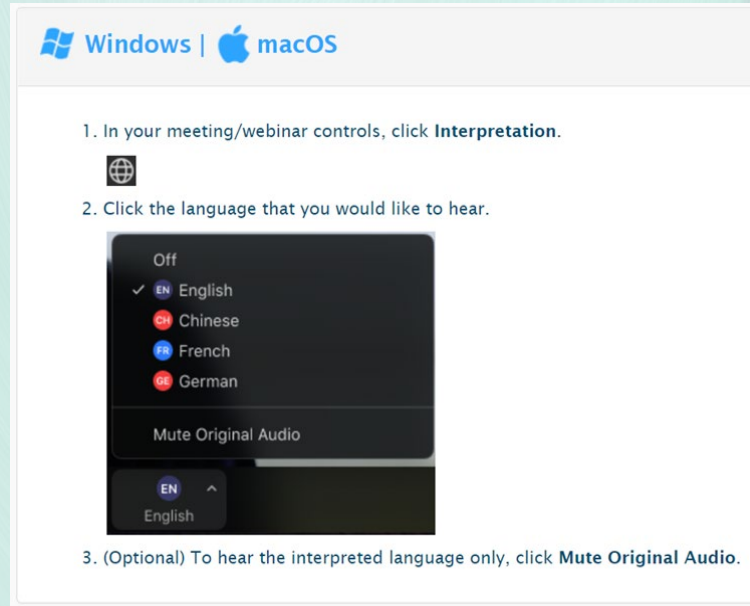
**¡Bienvenidos!**

The workshop will start at 9:02 A.M

El taller empezará a las 9:02 A.M.

# Listening to Language Interpretation

- In your meeting/webinar controls, click **Interpretation**. (located at bottom of screen)
- Click the language that you would like to hear. Options for this meeting are English and Spanish.
- To only hear the interpreted language, click **Mute Original Audio**.



- En los controles de su reunión/seminario web, haga clic en **Interpretación**. (ubicado en la parte inferior de la pantalla)
- Haga clic en el idioma que le gustaría escuchar. Las opciones para esta reunión son inglés y español.
- Para escuchar solo el idioma interpretado, haga clic en **Silenciar audio original**.



# **Concept Development Workshop #2**

TRU Part 2: Zero-Emission Non-Truck Transport Refrigeration Units

May 2024

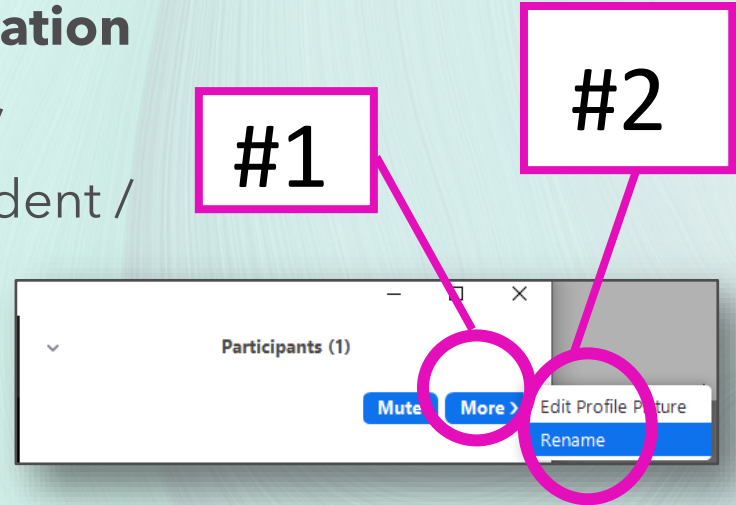
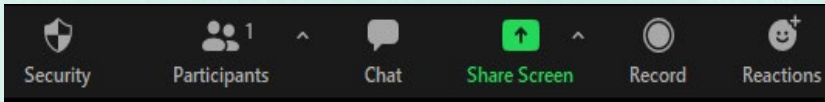
# Before We Get Started

- Please **mute** and **rename** yourself.

## First Name, Last Name - Affiliation

- Affiliations: Community Organization / Agency / Air District / Company / Resident / etc.

**Need help? - let us know in the Q&A.**



# Agenda

- Review of Goals for TRU Part 2
  - Recap Workshop #1
- Progress since Workshop #1 and Discussion
- Updated Concepts, Potential Concept, and Discussion
- Next Steps



## **Goals for TRU Part 2**

# Goals for TRU Part 2



Meet Governor's Executive Order N-79-20



Help attain regional air standards  
(support State Implementation Plan)



Cut community health risk  
(support Assembly Bill 617 emission reductions)



Mitigate climate change (support Scoping Plan and  
Short-Lived Climate Pollutant Reduction Strategy)

# Recap: Concept Development Workshop #1

## Background on TRUs

- What is a transport refrigeration unit (TRU)
- TRU classes
- TRU emissions inventory

## Pre-Regulation Development Work

- Outreach activities
- Zero-emission technology (2022 Technology Assessment)
- Cost input estimates
- 2022 Non-truck TRU Survey

## Infrastructure

- Coordination
- Planning process

## Initial Ideas for Concepts

- ZE turnover and manufacturing
- ZE certification
- Lower GWP standard
- Fleet reporting



# Additional Data Requested from Workshop #1

- Summary of data requests from workshop #1:
  - TRU fleet operations in-state and out-of-state
  - Fleet characteristics
  - TRU operations at applicable facilities
  - Zero-emission infrastructure projects
  - Zero-emission TRU and infrastructure costs
  - Zero-emission products, demonstration projects, and pilots
- Posted April 19, 2024, on TRU [Meetings and Workshops](#) page
- Please email [freight@arb.ca.gov](mailto:freight@arb.ca.gov) to set up a meeting





## **Progress since Workshop #1**

# TRU Webpage Resources

- Please visit the *TRU Meetings and Workshops Webpage* to find:
  - Helpful links and resources for fleet owners
  - Additional data requests staff is seeking
  - <https://ww2.arb.ca.gov/our-work/programs/transport-refrigeration-unit/tru-meetings-workshops>
- Please visit the *TRU Technology Assessment Webpage* to see updates to the 2022 TRU Technology Assessment
  - <https://ww2.arb.ca.gov/our-work/programs/transport-refrigeration-unit/tru-technology-assessments>

# Zero-Emission Technology Updates

- Updated Appendix A of the 2022 TRU Technology Assessment
- New trailer TRU projects
  - Semi-Direct-Drive Battery-Electric Hybrid eTRUs
  - Hydrogen fuel cell TRUs
  - Various companies, most major players in refrigerated transport
- New products for
  - Clip-On TRU Generator Sets
- TRU Powerpacks
  - Hydrogen fuel cell TRU powerpack
  - Sandia National Laboratories

# Updated Estimates for Equipment Cost Inputs (2023\$)

Input	Diesel Capital Cost	Zero-Emission Capital Cost
Trailer TRU	\$33,600	\$100,000 (battery-electric, 100-kWh) \$65,000+ (cryogenic)
Domestic Shipping Container TRU and Railcar TRU	\$33,600	\$100,000+ (battery-electric, 100-kWh+)
Underslung and Clip-on TRU Generator Sets	\$23,600	\$33,000+ (battery-electric, 40-kWh)
TRU Powerpack	\$420,000	\$1,000,000 (hydrogen fuel cell)
Battery Packs	N/A	\$400-650/kWh (trailer TRU)
Solar Array	N/A	\$20,000 (6-kW, including installation)
e-Axle/e-Hub	N/A	Seeking Info

# Day in the Life of a TRU

- Describes the operations of trailer TRUs, domestic shipping container (DSC) TRUs, railcar TRUs, and TRU generator sets
- Please give us feedback!



# Trailer TRUs



# Trailer TRUs

Home Base Facility / Point of Origin	<ul style="list-style-type: none"> <li>Refrigerated warehouse, distribution center, or cold storage warehouse (warehouses)</li> </ul>		
Route Description	<p><b>Over the road:</b></p> <ul style="list-style-type: none"> <li>Long-haul routes</li> <li>1-2 stops, up to 3-4 hours</li> </ul>	<p><b>Distribution/Grocery:</b></p> <ul style="list-style-type: none"> <li>Regional routes</li> <li>1-2 stops, up to 3-4 hours</li> </ul>	<p><b>Food Service:</b></p> <ul style="list-style-type: none"> <li>Regional and local routes</li> <li>Up to ~20 stops for 10 mins to 2 hours</li> </ul>
Other Considerations:	<ul style="list-style-type: none"> <li>Overnight and out of state travel</li> <li>Long periods of driving</li> <li>Long door openings</li> <li>Returns to home base facility after route is completed</li> </ul>	<ul style="list-style-type: none"> <li>May visit neighboring states</li> <li>Long periods of driving</li> <li>Long door openings</li> <li>Backhauls</li> <li>Returns to home base facility each night</li> </ul>	<ul style="list-style-type: none"> <li>Short periods of driving</li> <li>Short door openings</li> <li>Returns to home base facility each night</li> </ul>



# Additional Assumptions for Trailer TRUs

Trailer TRUs	<b>Transportation Operations</b> <ul style="list-style-type: none"><li>• Trailer TRUs without a home base facility (central place of business) will park at warehouses, yards, or retail parking (truck stops).</li><li>• Trailer TRUs without a home base facility will rely on retail infrastructure, refuel while at an origin warehouse, or contracts with sites for fuel.</li><li>• The operational characteristics of a leased trailer TRU of the same application as a privately owned TRU are the same.</li><li>• A trailer TRU can operate for up to 24 hours per day, but the engine runs for about 65% of that time. (Example: ~15 hours of runtime for 24 operating hours)</li></ul>

# Domestic Shipping Container TRUs



# Domestic Shipping Container TRUs

Points of Origin	<ul style="list-style-type: none"><li>• Refrigerated warehouse</li><li>• Manufacturing facility</li></ul>
Route Description	<ul style="list-style-type: none"><li>• Long-haul, intermodal routes</li><li>• Direct to customer, long door openings (2-4 hours)</li><li>• May sit up to 24 hours at an intermodal railyard</li><li>• Land bridge journey (2-15 days)</li><li>• Travels from California to Chicago to the East Coast</li></ul>
Other Considerations:	<ul style="list-style-type: none"><li>• Domestic shipping containers are heavier than trailers</li><li>• Overnight and out of state travel</li><li>• May sit at intermodal and container yards</li><li>• Travel on rail without refueling</li><li>• No home base facility</li></ul>

# Additional Assumptions for DSC TRUs

DSC TRUs	<p><b>Transportation Operations</b></p> <ul style="list-style-type: none"><li>• DSC TRUs are only fueled while at refrigerated warehouses and manufacturing facilities.</li></ul> <p><b>Stops</b></p> <ul style="list-style-type: none"><li>• DSC TRUs visit refrigerated warehouses, manufacturing facilities, and intermodal railyards. They do not generally visit grocery, retail, or seaport facilities.</li></ul>

# Railcar TRUs



# Railcar TRUs

Home Base Facility / Points of Origin	<ul style="list-style-type: none"><li>• Refrigerated warehouse with a rail track</li></ul>
Route Description	<ul style="list-style-type: none"><li>• Long-haul routes (2 to 15 days)</li><li>• Direct to customer, long door openings (2-3 hours)</li><li>• Travels from California to Chicago to the East Coast</li></ul>
Destinations	<ul style="list-style-type: none"><li>• Refrigerated warehouses with rail track, seaport facilities with rail track, or intermodal railyards</li></ul>
Other Considerations:	<ul style="list-style-type: none"><li>• Loaded and picked up from a warehouse with rail track</li><li>• Travels on rail without refueling</li><li>• Returns to a home base facility</li></ul>

# Additional Assumptions for Railcar TRUs

Railcar TRUs	<p><b>Transportation Operations</b></p> <ul style="list-style-type: none"><li>• Railcar TRUs are stored at refrigerated warehouses when not in use.</li><li>• Third-party fuel trucks may go to intermodal railyards or warehouses to refuel railcar TRUs.</li></ul> <p><b>Stops</b></p> <ul style="list-style-type: none"><li>• Railcar TRU stops are mainly at refrigerated warehouses.</li></ul>

# TRU Generator Sets



**Underslung**



**Clip-On**



**Powerpack**



# TRU Generator Sets

Home Base Facility / Point of Origin	<ul style="list-style-type: none"> <li>• Seaport facility or a yard near a seaport facility</li> <li>• Attached to refrigerated ocean containers loaded with freight</li> </ul>		
Route Description	<p><b>Underslung</b></p> <ul style="list-style-type: none"> <li>• Short-haul/regional routes</li> <li>• 1-2 stops, long door openings (2-4 hours)</li> <li>• May sit up to 24 hours at an intermodal railyard</li> </ul>	<p><b>Clip-On</b></p> <ul style="list-style-type: none"> <li>• Short-haul/regional/ long-haul routes</li> <li>• Land-bridge journey</li> <li>• 1-2 stops, long door openings (2-4 hours)</li> <li>• May sit up to 24 hours at an intermodal railyard</li> </ul>	<p><b>Powerpacks</b></p> <ul style="list-style-type: none"> <li>• Long-haul routes</li> </ul>
Other Considerations:	<ul style="list-style-type: none"> <li>• Do not travel on rail</li> <li>• Return to designated facility sites</li> </ul>	<ul style="list-style-type: none"> <li>• Used mainly for containers traveling by rail</li> </ul>	<ul style="list-style-type: none"> <li>• Powers up to 17 containers on a train</li> <li>• Stay on rail</li> </ul>

# Additional Assumptions for TRU Generator Sets

Underslung Generator Sets	<ul style="list-style-type: none"><li>• Underslung TRU generator sets do not generally travel more than 200 miles from the origin seaport.</li></ul>
Powerpacks	<ul style="list-style-type: none"><li>• Powerpacks do not travel to customer facilities.</li><li>• Powerpacks are refueled before routes at or around seaports.</li><li>• There are less than 50 TRU powerpacks operating in CA (~50 reported in ARBER).</li></ul>
All TRU Generator Sets	<ul style="list-style-type: none"><li>• TRU generator sets are stored at seaports or yards near seaports when not in use. They mainly visit warehouses, seaport facilities, and intermodal railyards. They may visit grocery stores and other retail sites.</li></ul>

# Discussion



Please raise your hand to speak or submit your question to the Q&A.



Please state your name and affiliation.

# Remaining Questions

- If your fleet's route has more than one stop, what is the average number of miles or hours between stop locations?
- If your fleet visits California, is it possible to dedicate units that visit?
- How many times a month is a powerpack or other TRU generator set used in lieu of shore power?
- What is the average number of operating hours per unit when a TRU generator set is used in lieu of shore power?

# Request for Additional Data

Please share feedback, additional data, and info with us by  
**June 30, 2024**

Send data to [freight@arb.ca.gov](mailto:freight@arb.ca.gov).

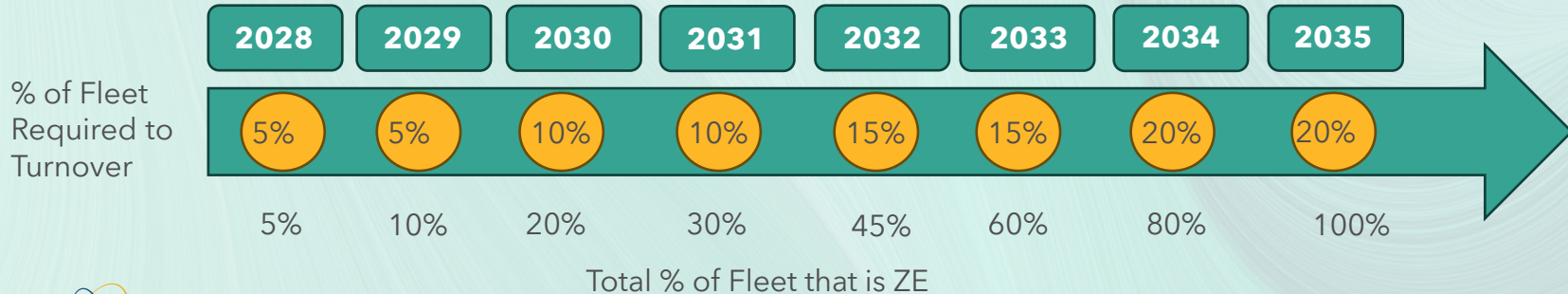


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## **Updated Concepts**

# Zero-Emission Fleet Transition Requirement

Effective Date	Requirement	Applicability
December 31, 2028	Fleets must turnover at least 5% of their fleet each year for the first 2 years. Then 10% for two years, 15% for two years, and 20% the last two years.	Trailer TRUs, DSC TRUs, railcar TRUs, underslung and clip-on TRU generator sets, and TRU powerpacks



# Refrigerant

Effective Date	Requirement	Applicability
December 31, 2032	Newly manufactured zero-emission TRUs must use a refrigerant with a global warming potential $\leq 5$ , or no refrigerant at all.	Truck TRUs, trailer TRUs, DSC TRUs, and railcar TRUs



# Applicable Facilities

- Applicable Facilities Under the TRU Airborne Toxic Control Measure

Current	Additional Facility
<ul style="list-style-type: none"><li>• <b>Refrigerated warehouses or distribution centers</b> with TRU activity (<math>\geq 20,000</math> square feet)</li><li>• <b>Grocery stores</b> with TRU activity (<math>\geq 15,000</math> square feet)</li><li>• <b>Seaport facilities</b> with TRU activity</li><li>• <b>Intermodal railyards</b> with TRU activity</li></ul>	<p><b>Inland/Dry Ports:</b></p> <p><i>Definition:</i> an inland site linked to an intermodal seaport or railyard. An inland or dry port engages in the transfer, storage, consolidation, or processing of cargo moved by shipping containers, truck trailers, or bulk cargo between the same or different modes of transportation that originated from or is destined to an intermodal seaport or railyard.</p>

# Potential Concept Needing Additional Input

- **Infrastructure Requirement**

- Goal: Ensure availability of zero-emission infrastructure at locations where TRUs operate
- Do you think an infrastructure requirement is needed?
- Should an infrastructure requirement be fuel specific?
- Are you planning to install infrastructure? Who is your utility provider?
- How many hours per day do you visit facilities or locations that may not own TRUs?
- Is industry discussing a potential standard? Should CARB be involved with setting a standard?



# Discussion



Please raise your hand to speak or submit your question to the Q&A.



Please state your name and affiliation.

# Next Steps

- Continue outreach and stakeholder discussions
- Continue to refine concepts based on input received
- Summer 2024
  - Baseline emissions inventory methodology workshop
  - Health benefit new end point methodology workshop
  - Begin cost analysis
- Fall 2024
  - Begin environmental impact analysis
  - Reg language and health risk assessment methodology workshop

# Staff Contacts

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**Please send written comments and supporting data  
to: [freight@arb.ca.gov](mailto:freight@arb.ca.gov)**



**Thank You!**