

MDV AND HDV DEVELOPMENT AND DEMONSTRATION ACTIVITIES IN CA

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DOE Hydrogen and Fuel Cell Technical Advisory
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CALIFORNIA AIR RESOURCES BOARD MISSION

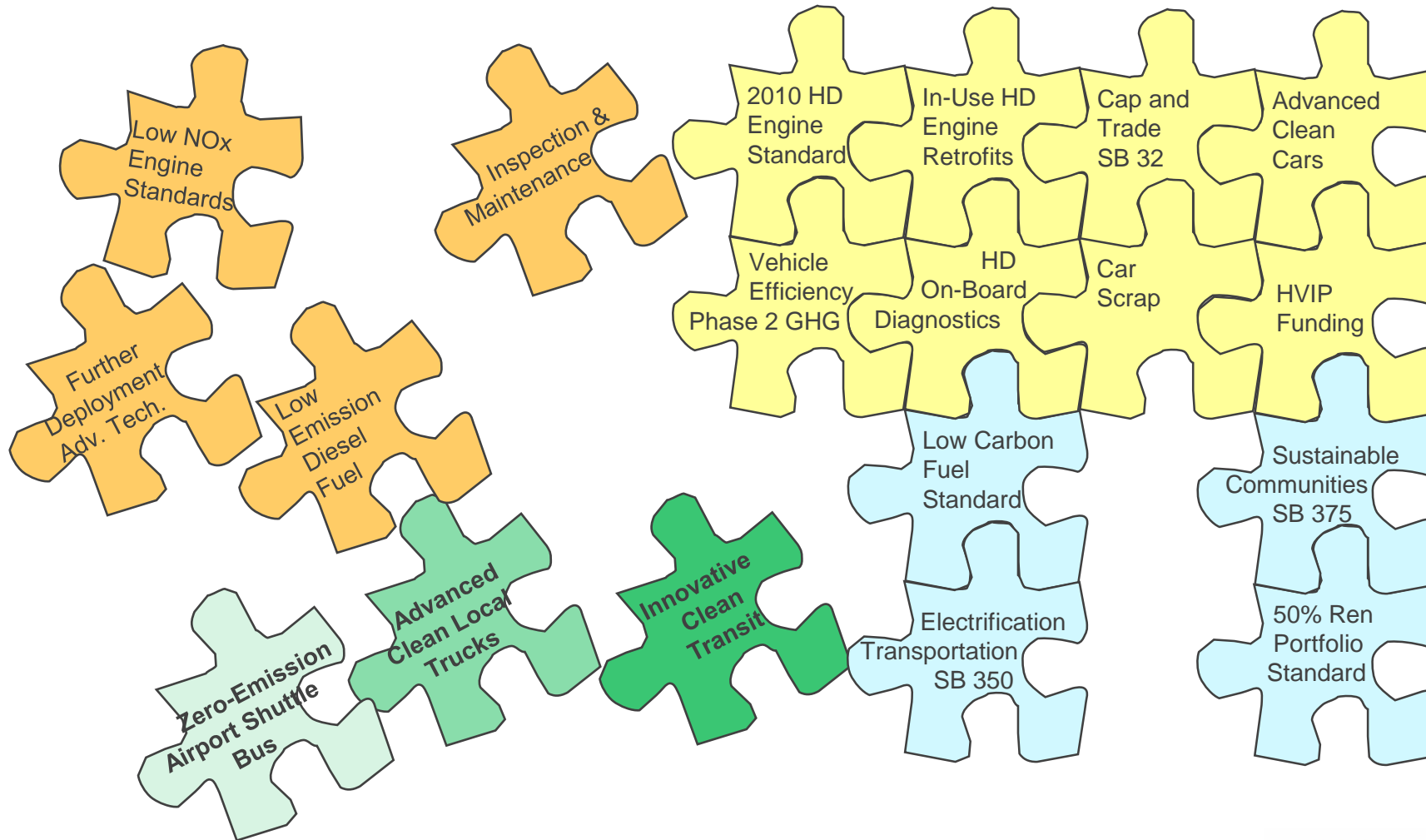
- Established in 1968 to promote and protect public health, welfare and ecological resources through the effective and efficient reduction of air pollutants, while recognizing and considering the effects on the state's economy
- 50th Anniversary
- Next 50 Years
 - Zero emission equipment everywhere feasible
 - Near-zero emission equipment powered by clean, low-carbon renewable fuels everywhere else



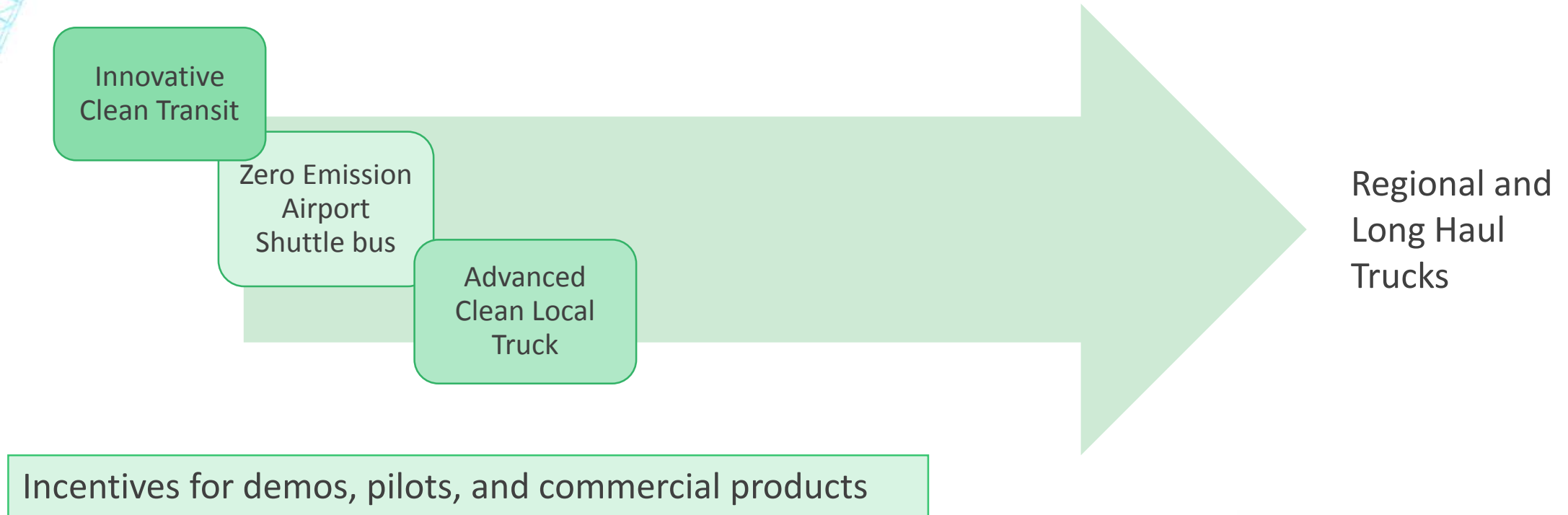
ADVANCED TECHNOLOGY POLICY FRAMEWORK

- Planning
 - Coordination of efforts between regions and agencies
- Investments
 - Enhance markets with strategic public incentive and investment programs
 - Significant funding prioritized for zero-emission transit, drayage trucks, and multisource facilities
- Regulations
 - Multi-pollutant approaches
 - Provide long term market signals

MOBILE SOURCE STRATEGIES

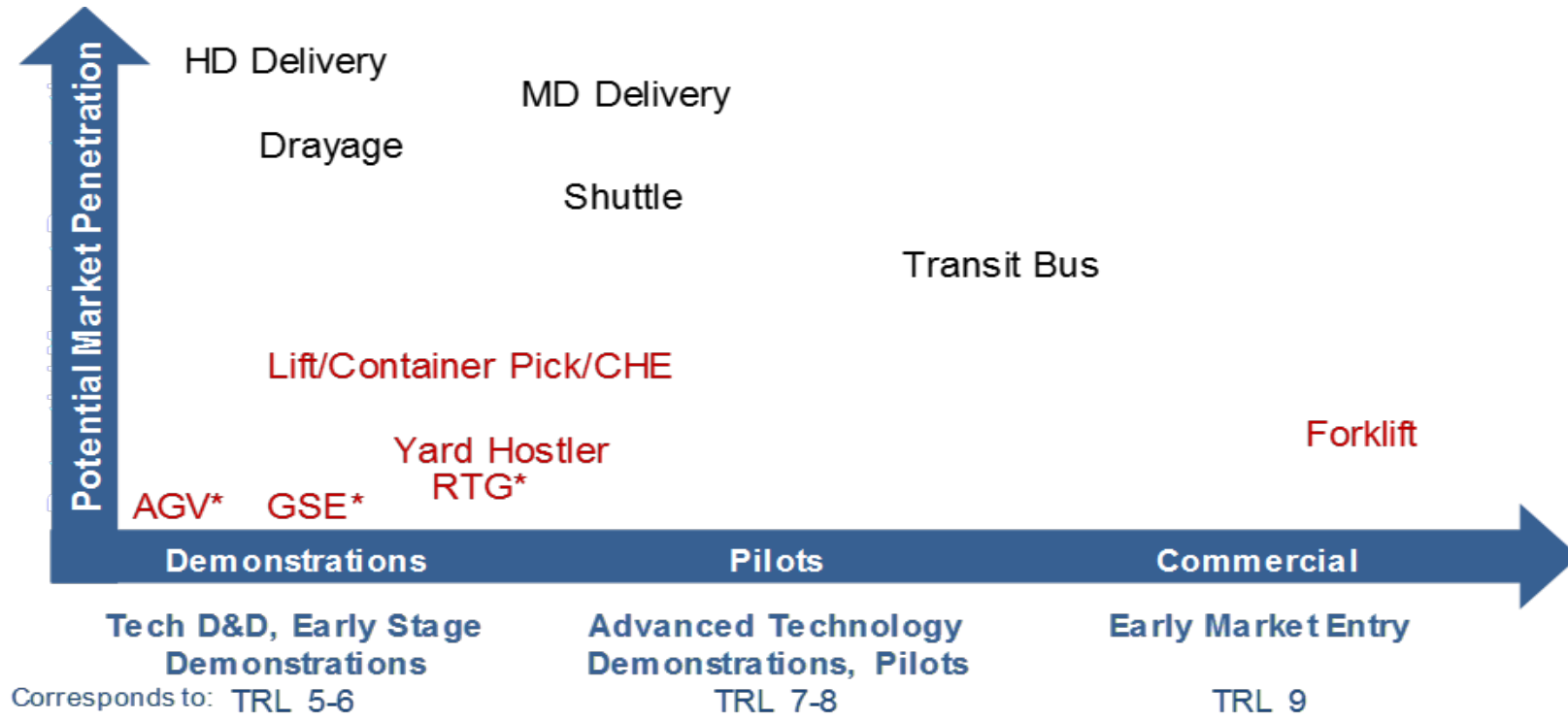


ON-ROAD ZERO EMISSION MD/HD MEASURES



3-YEAR INVESTMENT STRATEGY FOR HEAVY-DUTY VEHICLES/EQUIPMENT

Technology Status – Fuel Cell Electric



Key: Off-road shown in Red
 AGV = automated guided vehicle
 GSE = ground support equipment
 RTG = rubber tired gantry crane
 CHE = cargo handling equipment
 * Possible future applications



CARB INCENTIVES SUPPORT ZERO EMISSION TECHNOLOGY ADVANCEMENT

- Investments to support transformation of fleet to zero-emitting
- Helps meet long-term air quality and climate change goals
- Demonstration, early commercial pilots, and deployment of advanced heavy-duty technologies
 - Opportunities for fuel cell, battery electric, hybrid, low NOx engines, efficiency improvements
- Complement and support future regulatory efforts by accelerating the introduction of advanced technologies and encouraging fleets to purchase cleaner vehicles



EXAMPLES OF HEAVY-DUTY FUEL CELL VEHICLE PROJECTS

- FY 2015/2016 Zero-Emission Truck and Bus Commercial Pilot Deployments
 - Awarded \$35 million for 25 fuel cell electric buses + supporting fueling infrastructure
 - Implementation in progress
- 2017 On-Road and Off-Road Freight Advanced Technology Demonstrations
 - \$34 million available, eligible technologies include fuel cell vehicles
 - Awards to be announced soon, will include on- and off-road fuel cell vehicles
- Ongoing Clean Truck and Bus Vouchers
 - \$180 million available; 1st come, 1st served



UPCOMING FUNDING OPPORTUNITIES

- \$150 million for Zero- and Near Zero-Freight Facilities
 - For facilities to holistically overhaul operations
 - Demonstrate and deploy advanced equipment in pre-commercial or early commercial stages, including fuel cell technology
 - Under development, solicitation in first half of 2018
- \$40 million for Zero-Emission Off-Road Freight Equipment Vouchers
 - Commercially available fuel cell freight electric equipment would be eligible
 - Under development, expected to launch in 2018
- \$423 million for Volkswagen Environmental Trust
- Additional funding proposed in 2018-19 budget

INNOVATIVE CLEAN TRANSIT: LEADING THE WAY

- Goals
 - Send a clear market signal and provide certainty
 - Pave the way for all MD/HD vocations
 - Encourage innovative mobility options
- Proposal Overview
 - Phase-in ZEBs starting in 2020
 - Zero-emission end goal by 2040
 - Encourage early action with opportunities for funding
 - Provide regional flexibility and collaboration opportunities
 - 2:1 credit for fuel cell buses
- June 2018 – Board consideration



ZERO EMISSION BUSES IN CALIFORNIA



* As of September 2017, 27 transit agencies/universities in California have 107 zero emission buses (ZEBs) in operation and 340 on order/awarded, and 55 of these ZEBs are fuel cell electric buses (FCEBs)

FUEL CELL ELECTRIC BUSES IN CALIFORNIA

- Alameda-Contra Costa Transit District (AC Transit)
 - Largest FECB fleet in the U.S. since 2010 (13 buses)
 - Power plant exceeded 25,000 hours of operation, which is U.S. Department of Energy's ultimate performance target
 - 10 buses on order with next generation Ballard fuel cell
- SunLine Transit Agency
 - Longest FECB operation experience since 2000
 - Continued leadership in Center of Excellence and demonstration of H2 price at parity
 - 5 new FCEBs on order and new station to be the largest hydrogen electrolysis station in the U.S.
- Orange County Transportation Authority
 - 10 buses on order with next generation Ballard fuel cell

BUS EXPERIENCES AID OTHER MD/HD VEHICLE DEPLOYMENT

- Deployment experience
 - Curriculum for technician and operator training (SunLine + AC Transit)
 - Initial planning, maintenance and facility upgrades
 - Route management for fleets
- Technology transferability and synergies
 - Same electric drive components in multiple applications
 - Synergies between MD/HD on-road and off-road zero emission vehicles (ZEVs)



ADVANCED CLEAN LOCAL TRUCK

- Proposal Overview
 - Require chassis manufacturers to sell a portion of sales as zero-emission or zero-emission capable in California
 - Scope includes Class 2B-7 vehicles, Class 8 can earn credits
 - Begins with 2.5 percent sales requirement for 2023 model year
- Planned Schedule
 - November 2018 - Board consideration

Website: <https://www.arb.ca.gov/msprog/actruck/actruck.htm>





FUEL CELL ELECTRIC TRUCKS IN CALIFORNIA

- UPS delivery vehicles
 - DOE project converted 16 diesel-powered walk-in van to fuel cell.
 - The project plans to demonstrate and validate UPS service centers in West Sacramento, Oakland, San Bernardino, and Napa
- FedEx delivery vehicles
 - DOE project plans on integrating 20 battery electric trucks with fuel cell technology
 - Plan to operate fuel cell trucks in revenue service at several locations in California
- California ports
 - SCAQMD is testing hydrogen drayage trucks at the San Pedro Bay ports
 - Toyota is demonstrating a Class 8 hydrogen drayage truck and plans to build world's first megawatt-scale hydrogen power station at the Port of Long Beach with funding support from DOE

ON-ROAD ZERO EMISSION MD/HD MEASURES

Nikola and Tesla ?

Innovative
Clean Transit

Zero Emission
Airport
Shuttle bus

Advanced
Clean Local
Truck

Regional and
Long Haul
Trucks

Incentives for infrastructure, demos, pilots, and commercial products



OTHER CALIFORNIA HYDROGEN ACTIVITIES

- SB 1505:
 - Requires California to use 1/3 Renewable hydrogen production as transportation fuels by 2020
 - Goal is met today
- Low Carbon Fuel Standard regulation
 - A key part of a comprehensive set of California programs to cut GHG emissions by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options
 - Propose to designate that the fueling facility owner as the reporting party with the first right of refusal to generate the credits

THANK YOU

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