



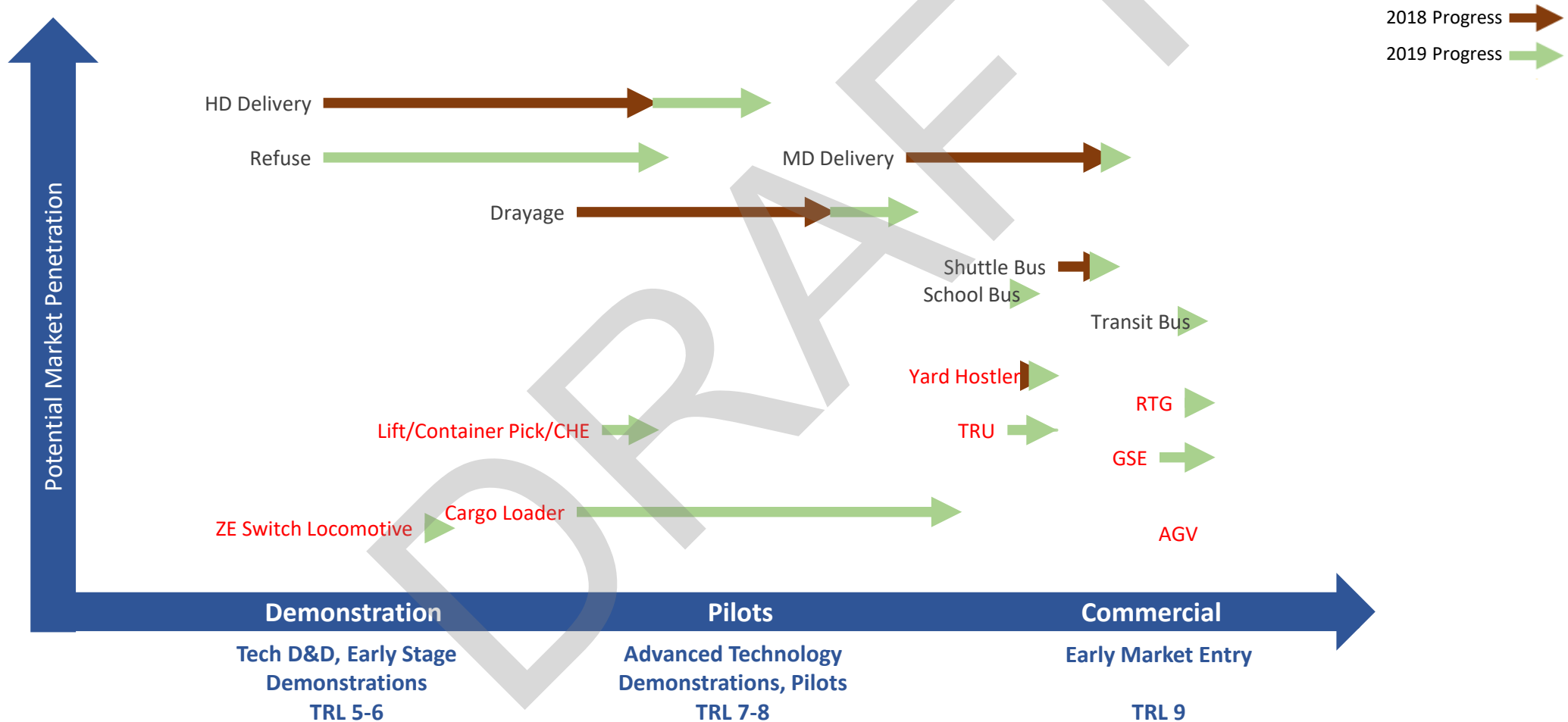
CALIFORNIA  
AIR RESOURCES BOARD



# Tech Status Updates

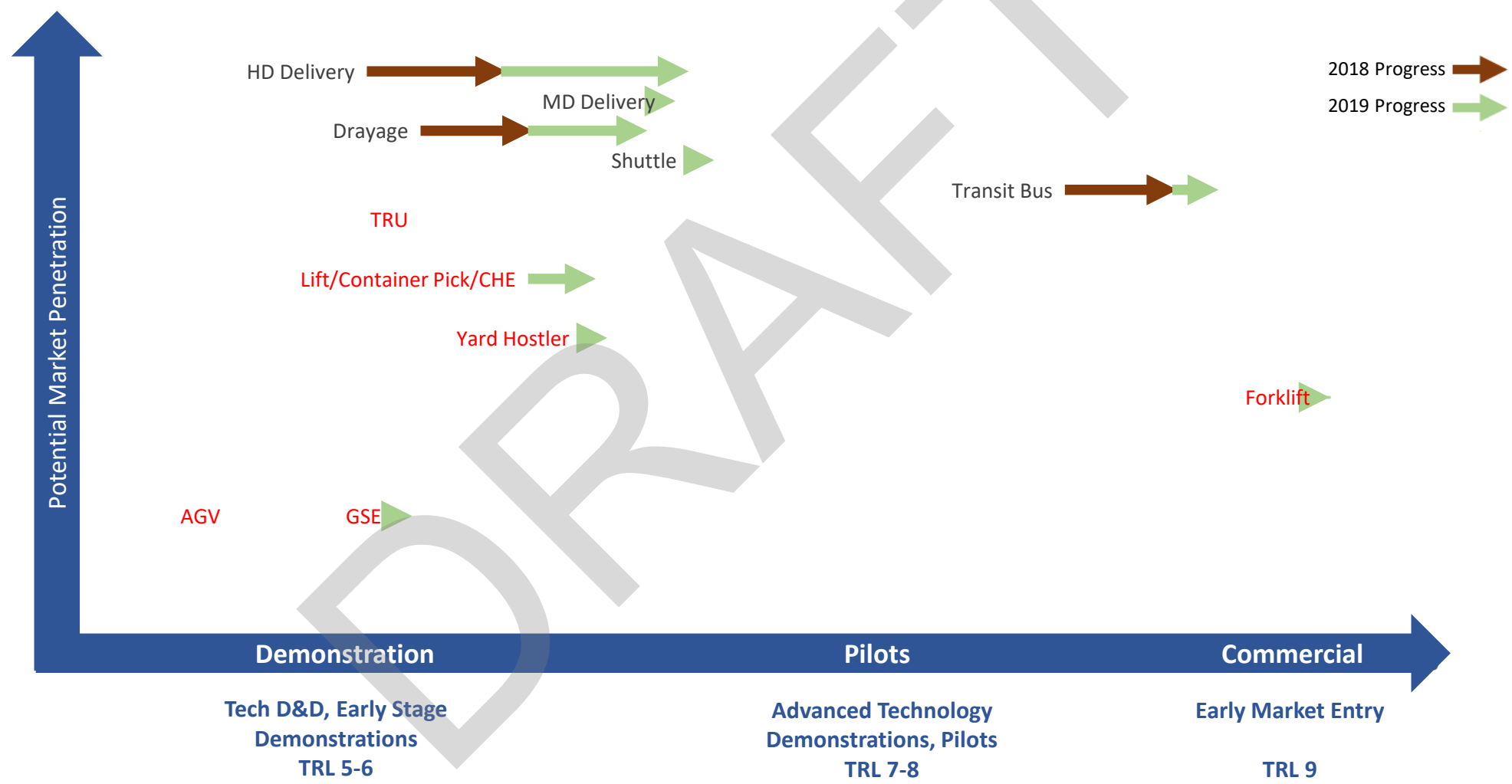
- ZEV: BEV; FCEV; HEV
- Low NOx
- Efficiencies

# BEV Technology Readiness Levels – 2019 Update



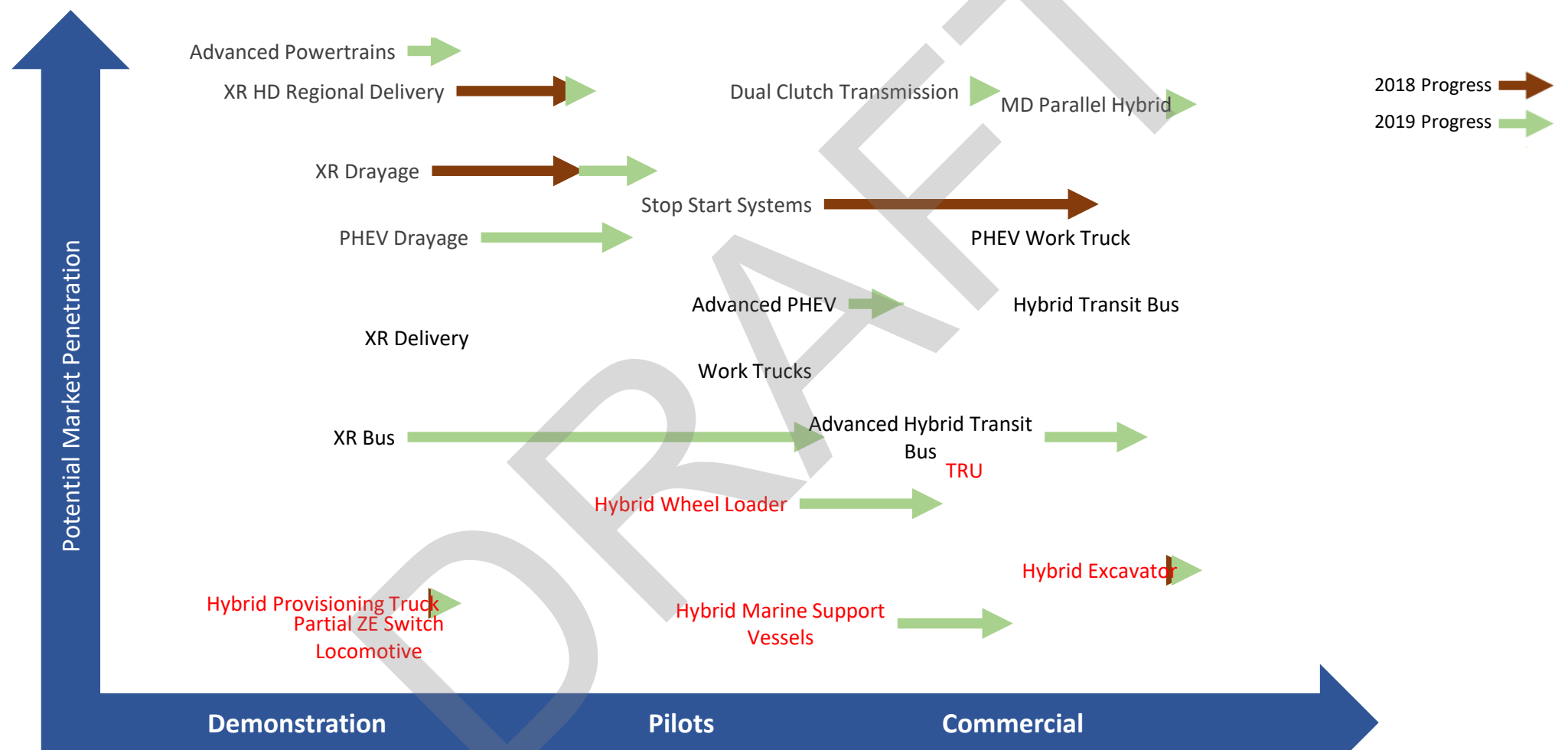
On-Road Platforms in Black  
 Off-Road Platforms in Red  
 Abbreviations will be listed in final tables

# FCEV Technology Readiness Levels – 2019 Update



On-Road Platforms in Black  
 Off-Road Platforms in Red  
 Abbreviations will be listed in final tables

# HEV Technology Readiness Levels – 2019 Update



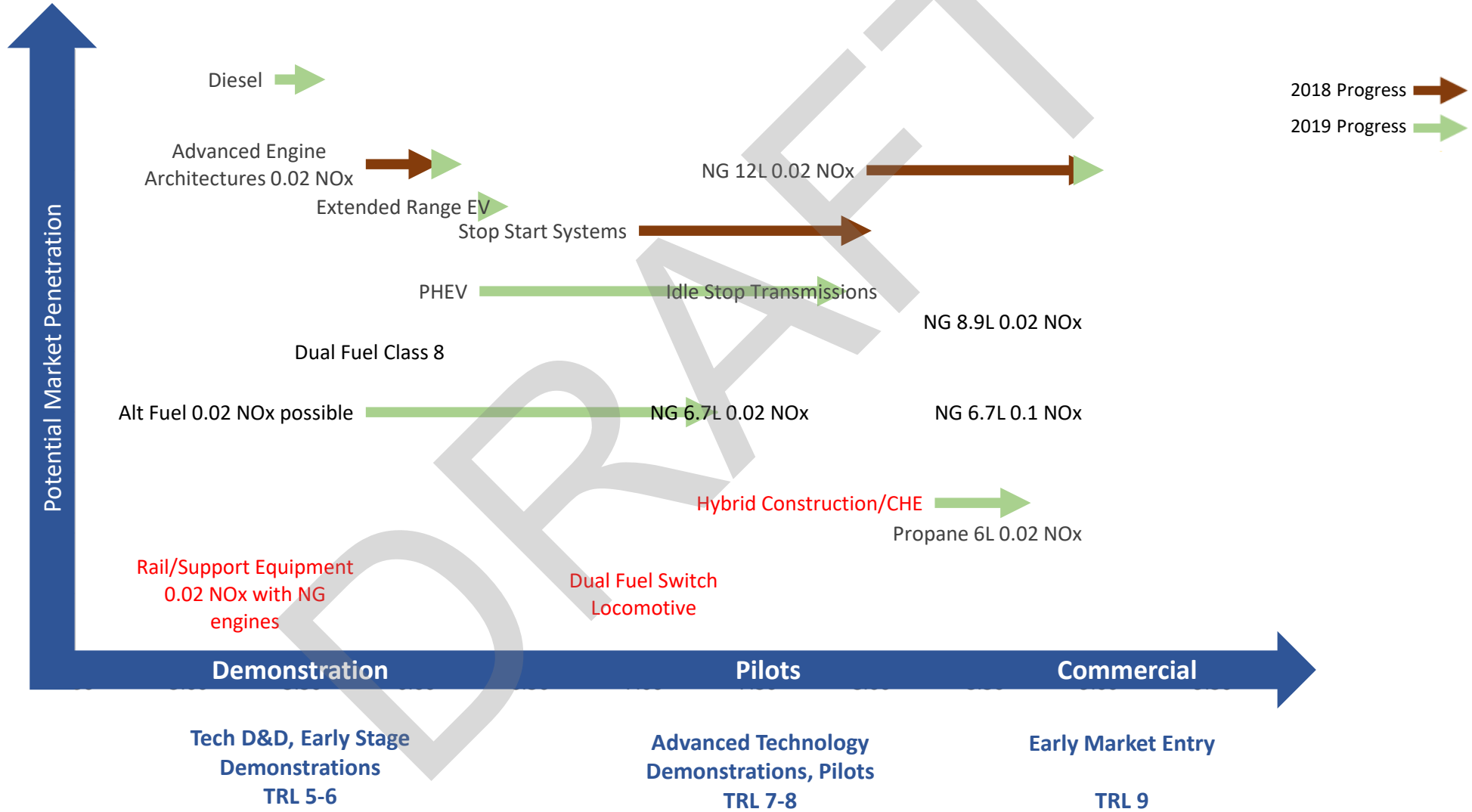
**Demonstration**      **Pilots**      **Commercial**

Tech D&D, Early Stage Demonstrations      Advanced Technology Demonstrations, Pilots      Early Market Entry

TRL 5-6      TRL 7-8      TRL 9

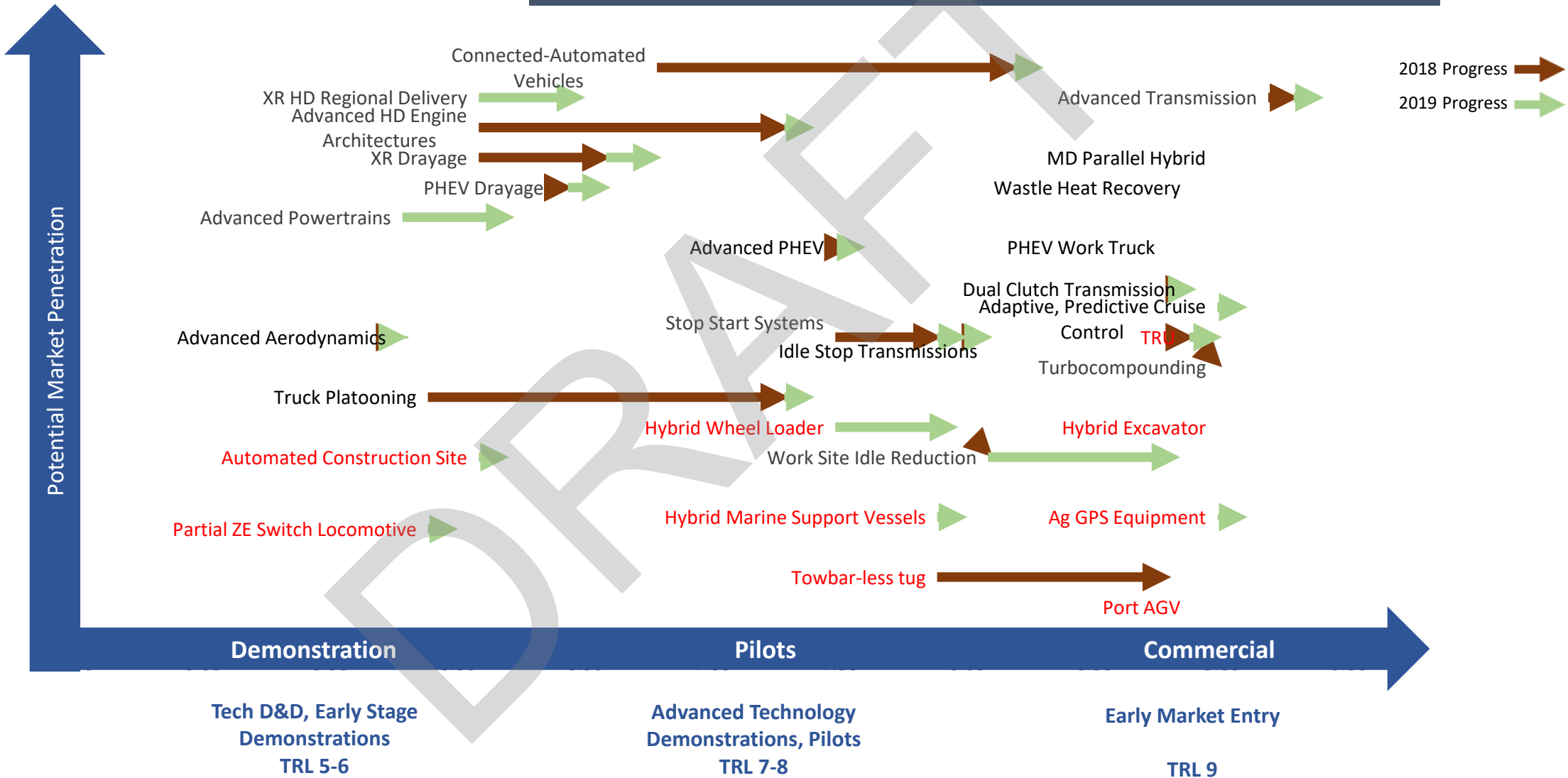
On-Road Platforms in Black  
 Off-Road Platforms in Red  
 Abbreviations will be listed in final tables

# Low NOx Engine Technology Readiness Levels - 2019 Update



On-Road Platforms in Black  
 Off-Road Platforms in Red  
 Abbreviations will be listed in final tables

# Efficiencies Technology Readiness Levels - 2019 Update

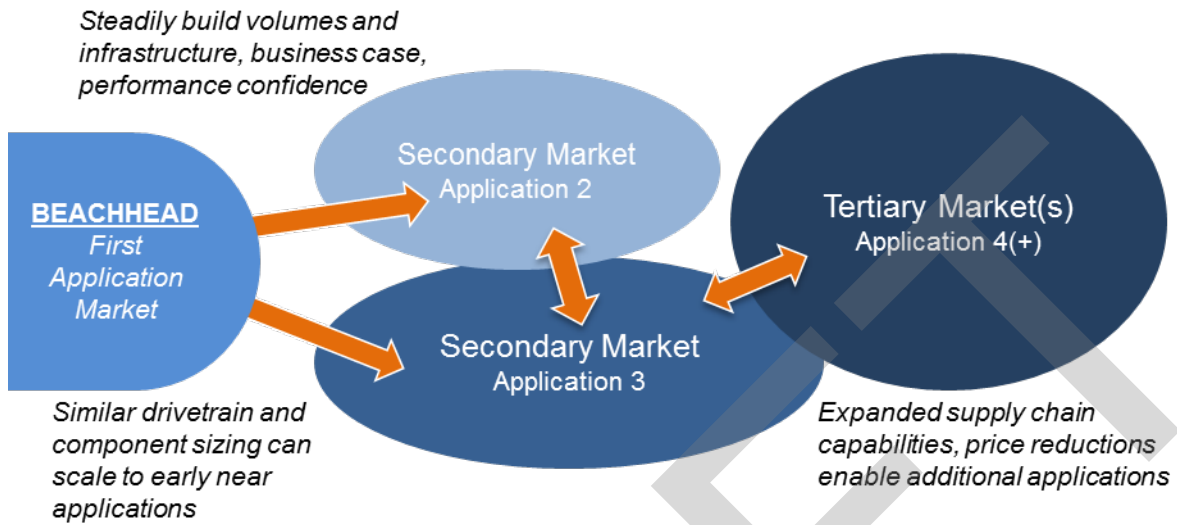


On-Road Platforms in Black  
 Off-Road Platforms in Red  
 Abbreviations will be listed in final tables

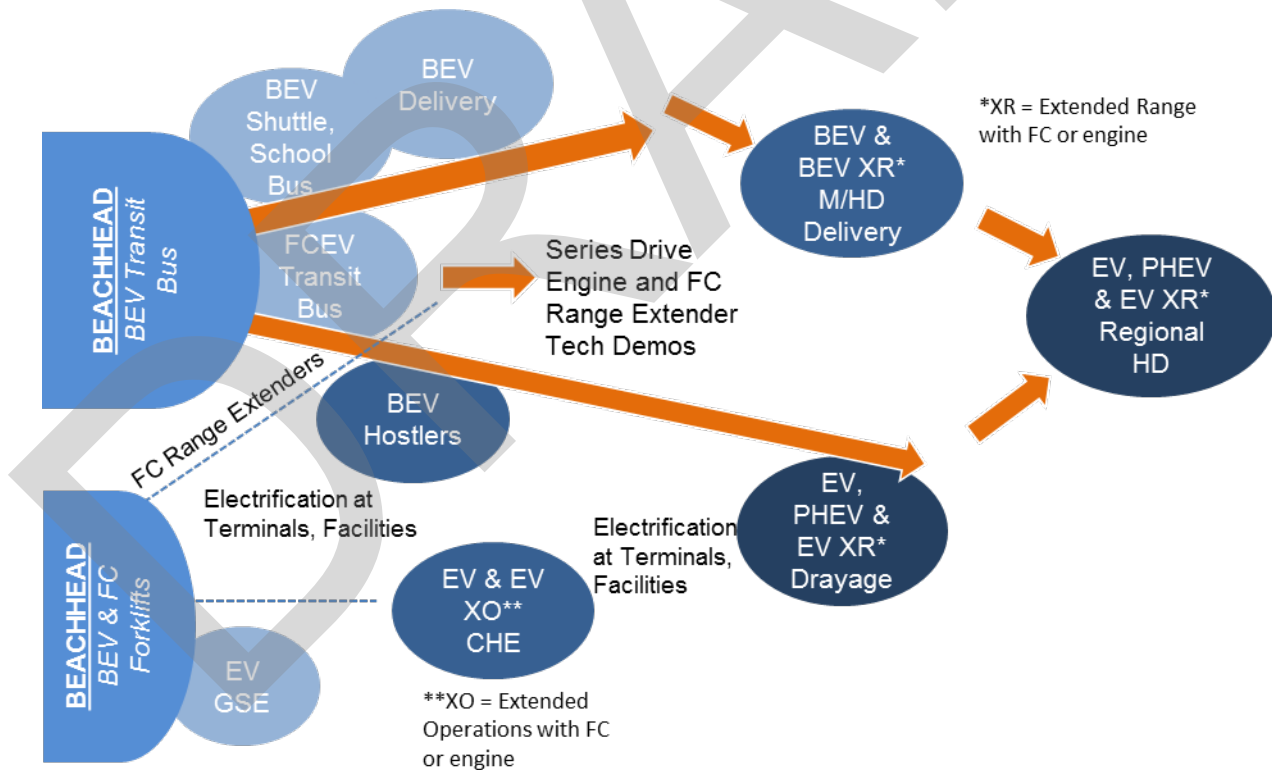
# Beachheads

- ZEV Updates
- Low NOx
- Efficiencies Updates

## Beachhead Process

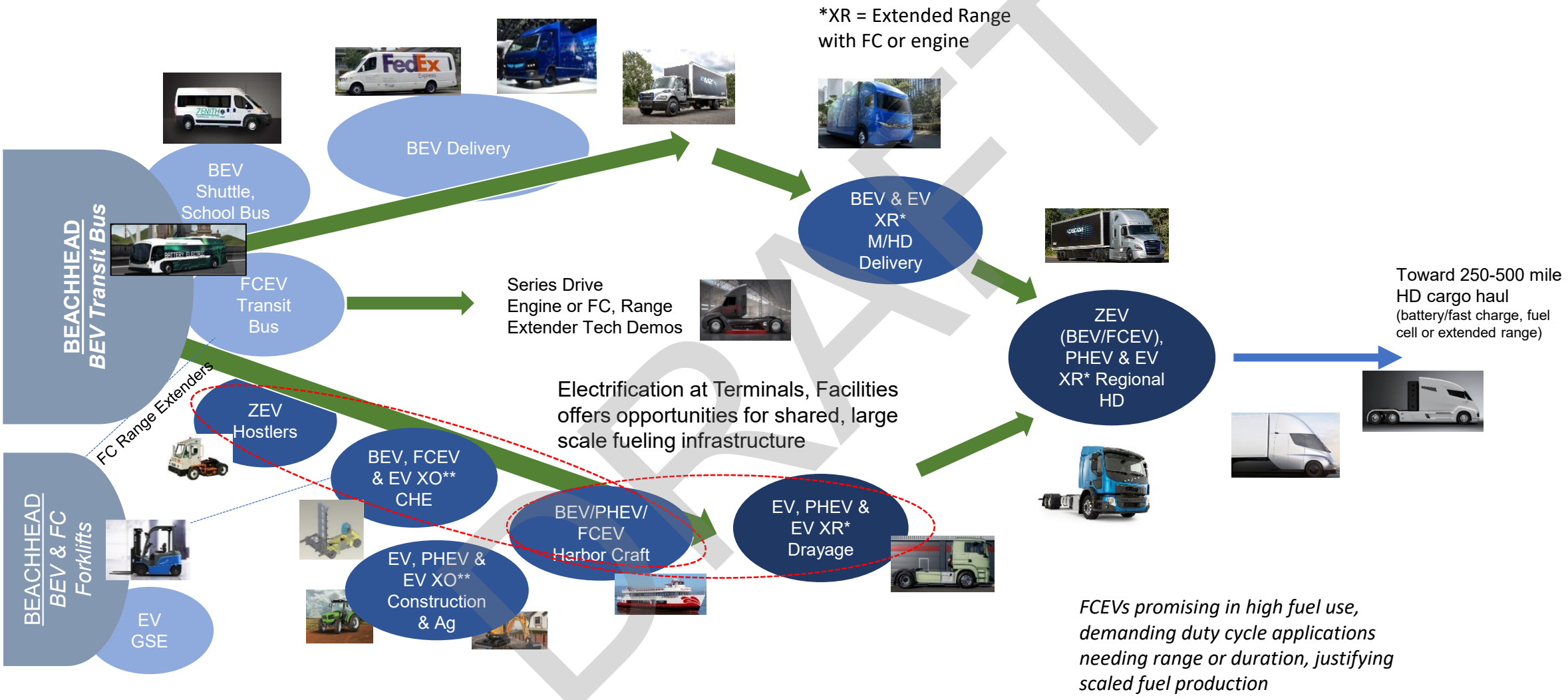


## ORIGINAL Zero-Emissions Beachhead: BEV Transit Bus





# Zero Emission Beachhead, Pathways

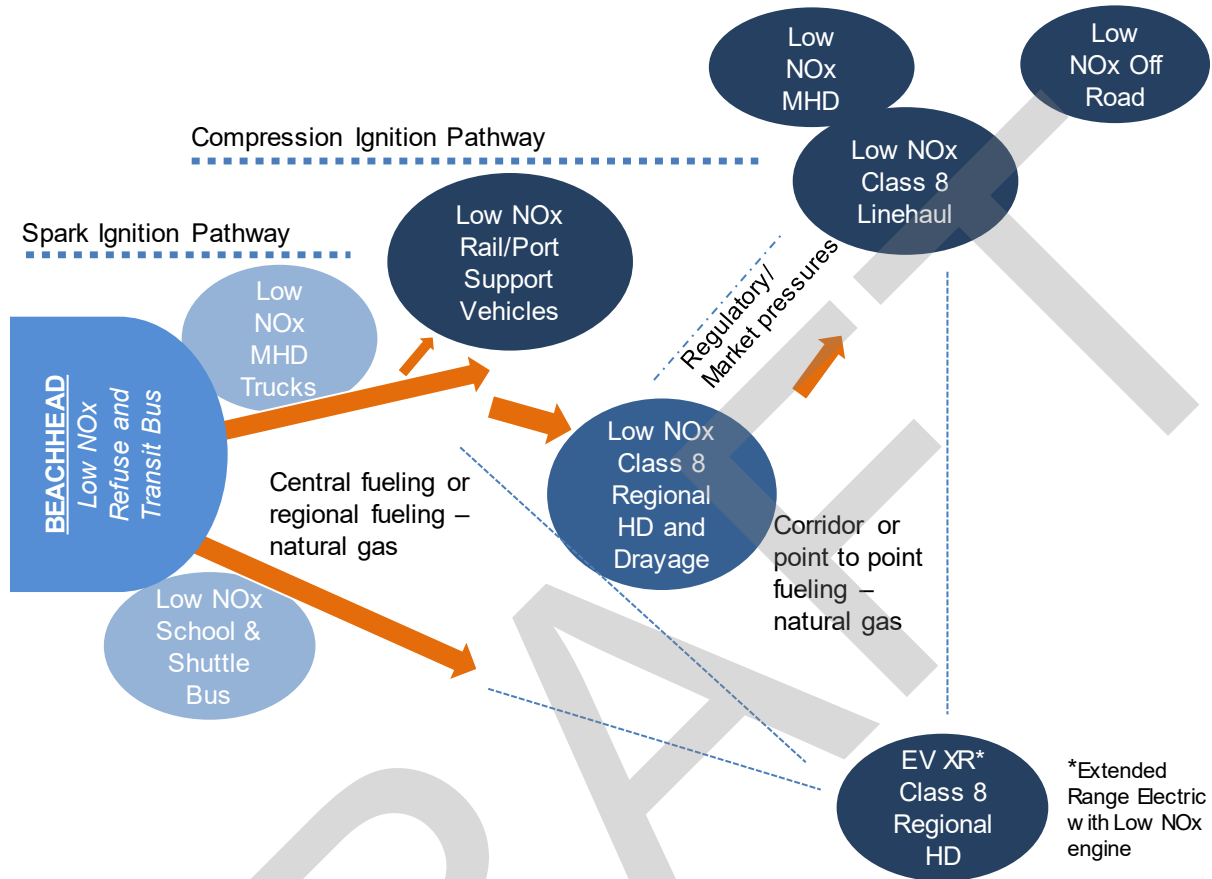


\*XR = Extended Range with FC or engine

\*\*XO = Extended Operations with FC or engine

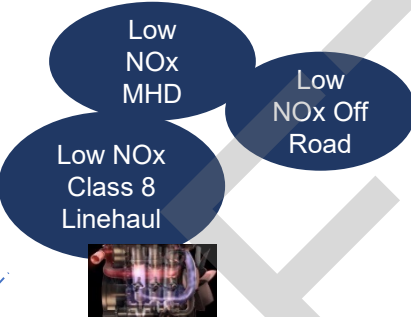


# ORIGINAL Low NOx Engine Beachhead: Refuse and Transit Bus



# Low NOx Beachhead, Pathways

Compression Ignition Pathway



**BEACHHEAD**  
Low NOx  
Refuse and  
Transit Bus



Low NOx  
MHD Trucks

Central fueling or  
regional fueling –  
natural gas/propane

Low NOx  
School &  
Shuttle  
Bus



Low NOx  
Rail/Port  
Support &  
Ag  
Equipment



Low NOx  
Class 8  
Regional  
HD and  
Drayage

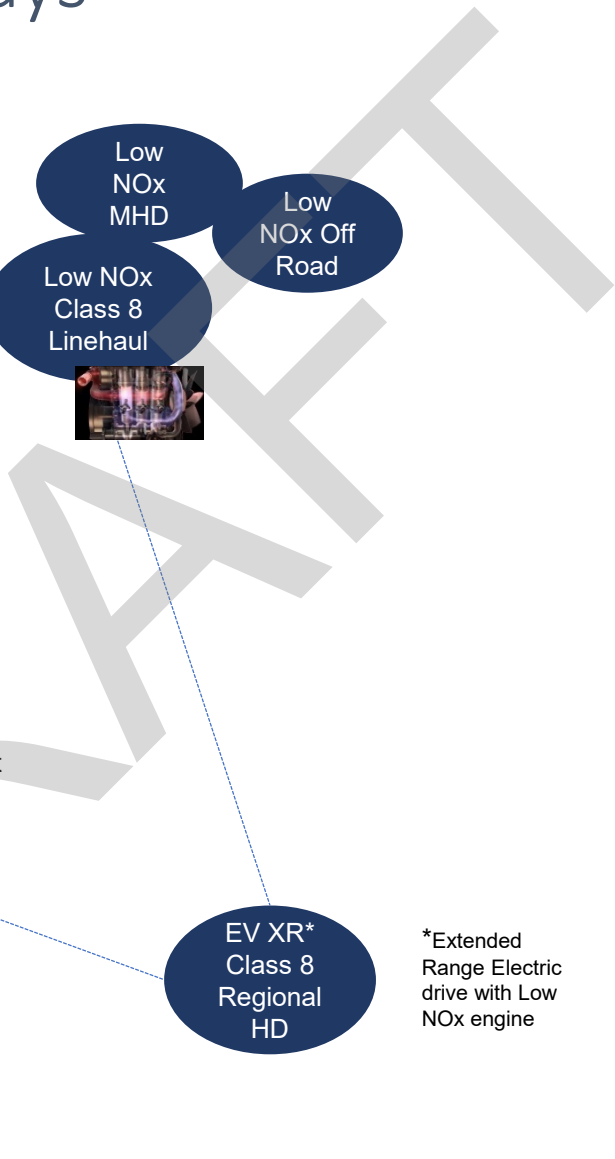
Regulatory /  
Market pressures

Corridor or  
point to point  
fueling –  
natural gas

EV XR\*  
Class 8  
Regional  
HD

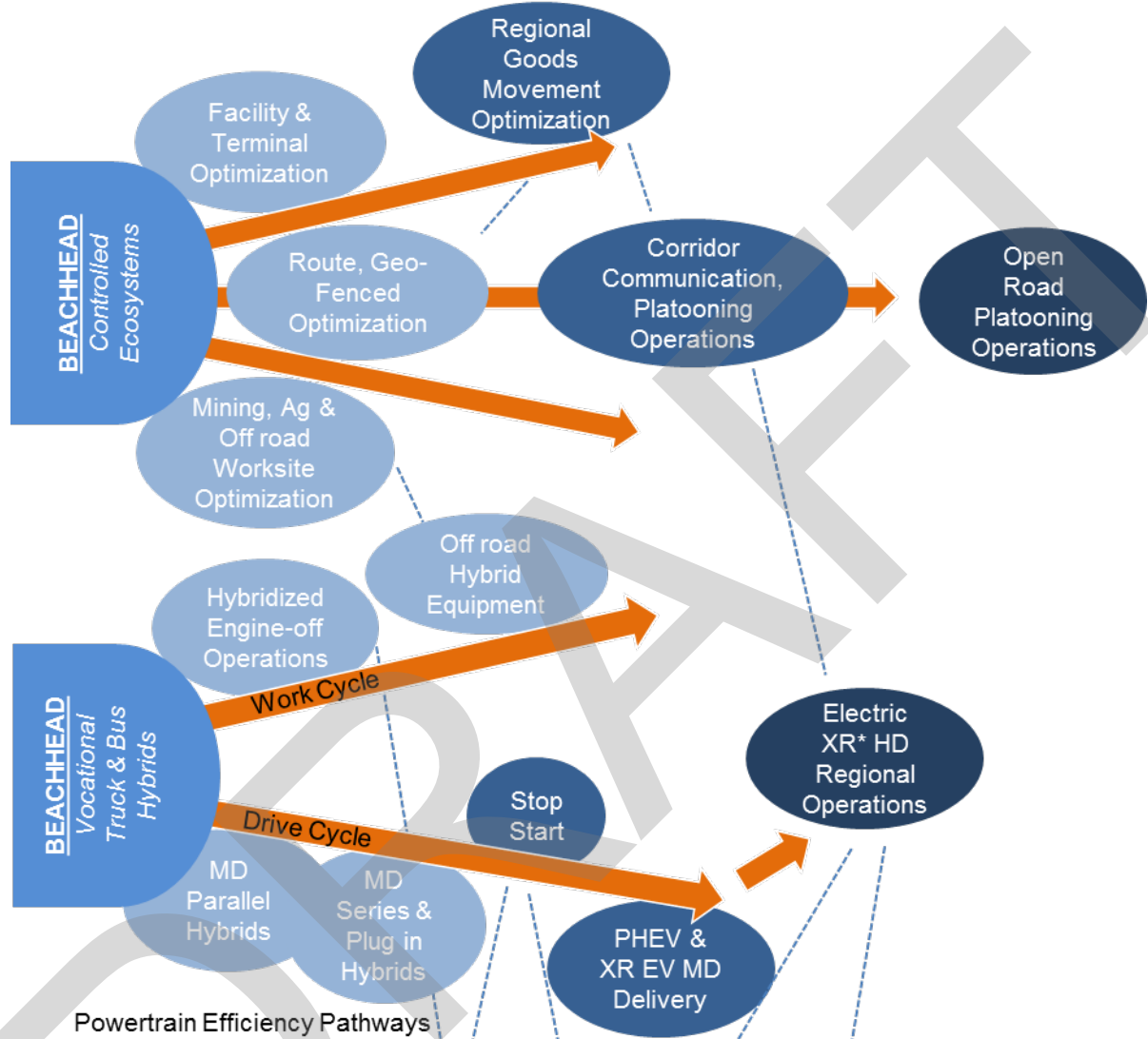
\*Extended  
Range Electric  
drive with Low  
NOx engine

Spark Ignition Pathway

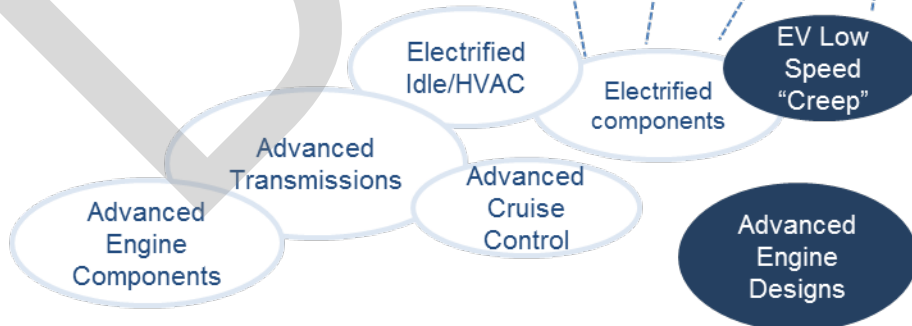


# ORIGINAL Efficiency Beachheads: Controlled Ecosystems and Vocational Hybridization

Operational Energy Efficiency (Connected/Automated/ITS) Pathway



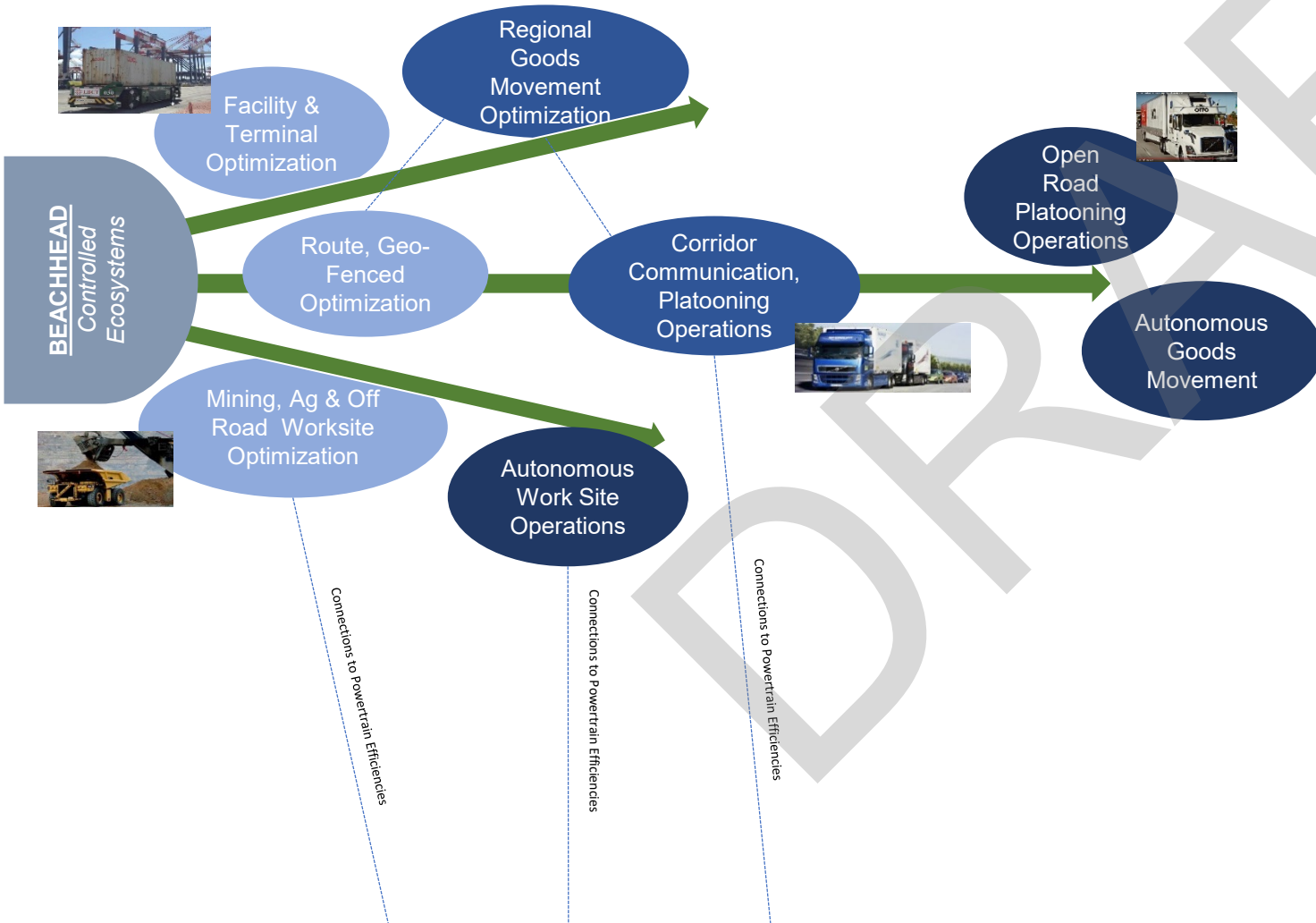
Powertrain Efficiency Pathways



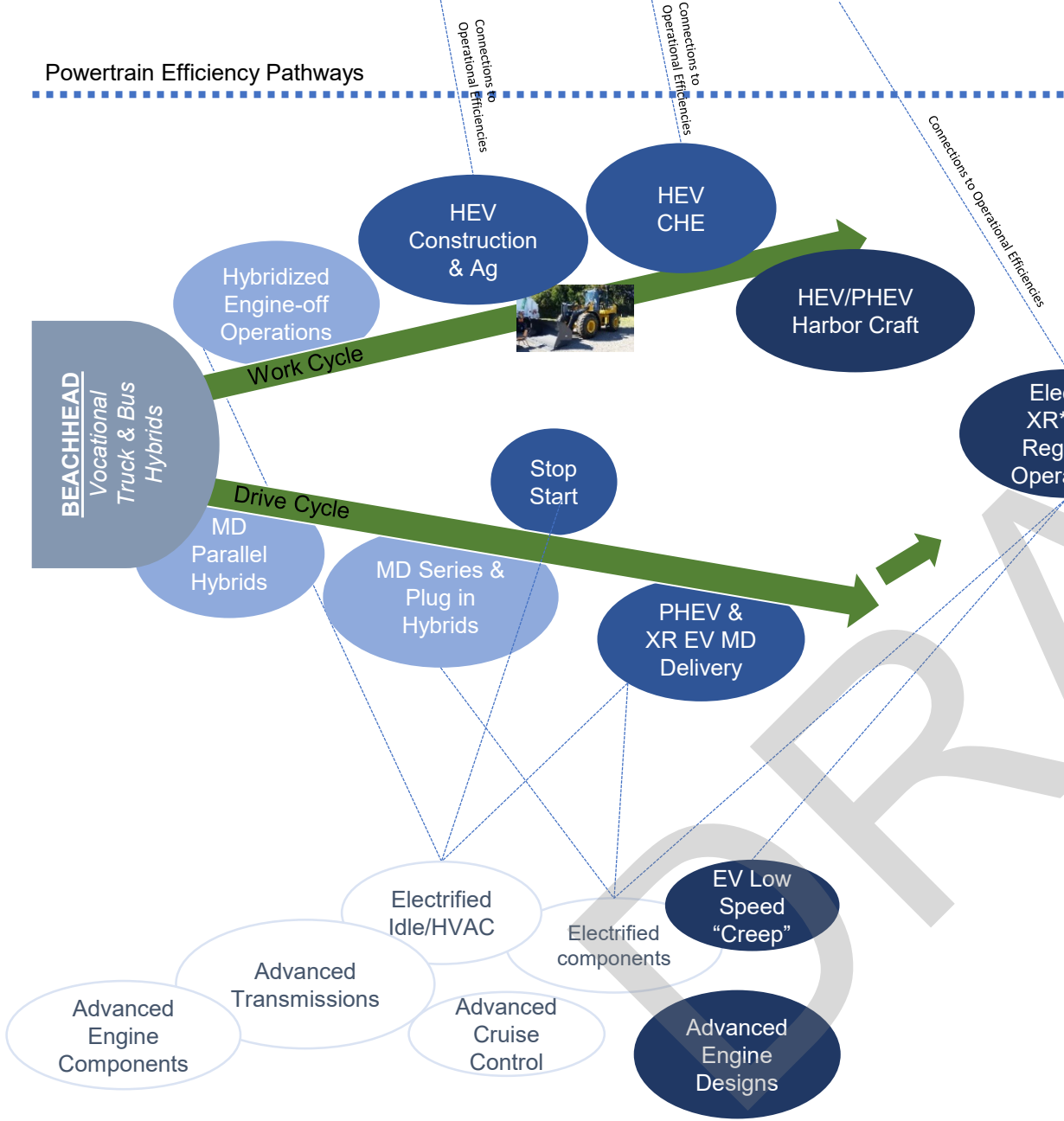
Class 8 Tractor Efficiency Pathway (investments to leverage)

# Operational Efficiency Beachhead, Pathways

Operational Energy Efficiency (Connected/Automated/ITS) Pathway



# Powertrain & Engine Efficiency Beachhead, Pathways



Class 8 Tractor Efficiency Pathway (investments to leverage)

# Three-Year Investment Priorities Table

## THREE-YEAR HEAVY-DUTY STRATEGY INVESTMENT PLAN UPDATE\*

	FY 2020-21	FY 2021-22	FY 2022-23
<b>Demos</b>	<i>\$60-\$85 Million</i> Focus: ZE/PHEV HD Regional Delivery, ZE/Hybrid Ag-Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment, ZE/Hybrid Marine	<i>\$50-\$90 Million</i> Focus: ZE/PHEV Longer Range HD Goods Movement, ZE/PHEV Ag-Construction Equipment, ZE/Hybrid Heavier Cargo Handling Equipment, ZE/Hybrid Marine	<i>\$50-\$90 Million</i> Focus: ZE Longer Range HD Goods Movement, ZE Construction Equipment, ZE Heavier Cargo Handling Equipment, ZE Rail, ZE/Hybrid Marine
<b>Pilots</b>	<i>\$185-\$310 Million</i> Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Heavier Cargo Handling Equipment, ZE Facilities	<i>\$200-\$325 Million</i> Focus: ZE/PHEV Drayage and Regional Delivery, Advanced Powertrains, ZE/Hybrid Ag-Construction- Heavier Cargo Handling Equipment, ZE/Hybrid Marine, ZE Facilities	<i>\$200-\$325 Million</i> Focus: ZE Longer Range Goods Movement, Advanced Powertrains, ZE Ag-Construction-Heavier Cargo Handling Equipment, ZE/Hybrid Marine, ZE Facilities
<b>Commercial</b>	<i>\$365-\$545 Million</i> Focus: ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, Ground Support Equipment, ZE/Hybrid Heavier Cargo Handling Equipment	<i>\$420-\$580 Million</i> Focus: ZE/PHEV Drayage and Regional Delivery, ZE Delivery, ZE Transit, Low NOx Linehaul Trucks, ZE/Hybrid Heavier Cargo Handling Equipment	<i>\$425-\$585 Million</i> Focus: ZE/PHEV Drayage and Regional HD Delivery, ZE Delivery, ZE Transit, ZE/Hybrid Heavier Cargo Handling Equipment, ZE/Hybrid Marine
<b>Total Funding</b>	<b>\$610-\$940 Million*</b>	<b>\$670-\$995 Million*</b>	<b>\$675-\$1,000 Million*</b>

*Three-year funding plan investment priorities define yearly focus areas and propose funding that aligns with progress required for each key pathway.*

*\* The draft funding amounts listed here represent a critical down payment towards meeting the funding need outlined at the beginning of this section, but do not meet the entire need.*