Scenarios

- Initial Set of Scenarios to Initiate Discussion with Working Group Participants
- For Illustrative Purposes
  - Does Not Reflect Control Strategies to Achieve Scenario Levels
- Provides Information for Discussion on Areas to Focus Future Technology Development/ Commercialization and Timing for Deployment
- Additional Scenarios May Be Developed Based on Discussion with Working Group Participants

Scenarios Developed

- Baseline Emissions – 2023, 2032
- Equal Share Reductions (Across-the-Board)
- All Sources at Greatest Level of Control Based on Existing Emission Standards
- Certain Emission Sectors with 90% Greater Reductions than Existing Emission Standards
- Increase Penetration of Zero-Emission Technologies

Scenario Assumptions – On-Road

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Goods Movement Sources - NOx Emissions (Tons Per Day) - 2023									
Source	Population	VMT (miles/day)	Baseline	Equal Share Target (-65%)	100% Existing Standards*	90% Cleaner Combustion Technologies**	ATP1 - 25% Zero / 75% Near-Zero	ATP2 - 50% Zero / 50% Near-Zero	ATP3 - 75% Zero / 25% Near-Zero
Light Heavy Duty Gas Trucks-1 (8501-10000 lb.)	315,011	13,400,938	10.93	3.83	4.22	4.22	3.17	2.11	1.06
Light Heavy Duty Gas Trucks-2 (10001-14000 lb.)	32,770	1,407,062	1.00	0.35	0.48	0.48	0.36	0.24	0.12
Medium Heavy Duty Gas Trucks (14001-33000 lb.)	26,017	1,046,000	1.08	0.38	0.38	0.04	0.03	0.02	0.01
Heavy Heavy Duty Gas Trucks (>33000 lb.)	1,776	173,000	0.86	0.30	0.74	0.07	0.06	0.04	0.02
Light Heavy Duty Diesel Trucks-1 (8501-10000 lb.)	101,566	4,150,710	9.74	3.41	2.12	2.12	1.59	1.06	0.53
Light Heavy Duty Diesel Trucks-2 (10001-14000 lb.)	33,579	1,360,290	3.19	1.12	0.79	0.79	0.59	0.39	0.20
Medium Heavy Duty Diesel Trucks (14001-33000 lb.)	89,766	4,609,000	4.99	1.75	4.73	0.47	0.35	0.24	0.12
Heavy Heavy Duty Diesel Trucks (>33001 lb.)	90,511	10,412,000	31.39	10.99	28.80	2.88	2.16	1.44	0.72
Total	**690,995**	**36,559,000**	**63.18**	**22.11**	**42.25**	**11.07**	**8.30**	**5.53**	**2.77**

Passenger Transportation Sources - NOx Emissions (Tons Per Day) - 2023									
Source	Population	VMT (miles/day)	Baseline	Equal Share Target (-65%)	100% Existing Standards*	90% Cleaner Combustion Technologies**	ATP1 - 25% Zero / 75% Near-Zero	ATP2 - 50% Zero / 50% Near-Zero	ATP3 - 75% Zero / 25% Near-Zero
Light Duty Passenger	6,045,577	202,227,892	12.34	4.32	5.17	5.17	3.88	2.58	1.29
Light Duty Trucks-1 (up to 3750 lb.)	716,203	24,037,227	4.33	1.52	0.98	0.98	0.73	0.49	0.24
Light Duty Trucks-2 (3751 to 5750 lb.)	2,036,593	73,251,629	7.66	2.68	2.86	2.86	2.15	1.43	0.72
Medium Duty Trucks (5751-8500 lb.)	1,703,888	56,678,252	11.92	4.17	2.82	2.82	2.11	1.41	0.70
Heavy Duty Diesel Urban Buses	7,613	815,970	10.43	3.65	0.50	0.05	0.04	0.02	0.01
Heavy Duty Gas Urban Buses	1,958	210,257	0.61	0.21	0.08	0.01	0.01	0.00	0.00
School Buses - Gas	1,683	60,450	0.07	0.02	0.01	0.00	0.00	0.00	0.00
School Buses - Diesel	4,770	170,017	1.73	0.61	0.28	0.03	0.02	0.01	0.01
Other Buses - Gas	7,417	277,729	0.5	0.18	0.18	0.02	0.01	0.01	0.00
Other Buses - Diesel	6,444	528,964	0.94	0.33	0.94	0.09	0.07	0.05	0.02
Motor Homes	83,646	948,629	0.97	0.34	0.53	0.05	0.04	0.03	0.01
Motorcycles	239,153	1,734,034	2.03	0.71	2.03	2.03	2.03	2.03	2.03
Total	**10,854,946**	**360,941,049**	**53.53**	**18.74**	**16.36**	**14.10**	**11.09**	**8.07**	**5.05**

Assumptions:

*100% Existing Standards:

(1) Vehicles w/ weight up to 14,000 lbs (PC, LDT1, LDT2, MDV, LHD1, LHD2): All MY vehicles emit at 100% ACC phase-in emission level (2025-2032 MY fleet average)

(2) Vehicles w/ weight 14,000+ lbs (MHDT, HHDT, UBUS, SBUS, OBUS, MH): pre-2010 MY vehicles emit at **2010 emission level (2010-2023 MY fleet average)**

**90% Cleaner Combustion Technologies (100% Penetration of "Near-Zero" Technologies"):

(1) Vehicles w/ weight up to 14,000 lbs (PC, LDT1, LDT2, MDV, LHD1, LHD2): same as 100% Existing Standards scenario (100% ACC)

(2) Vehicles w/ weight 14,000+ lbs (MHDT, HHDT, UBUS, SBUS, OBUS, MH): linear reduction (90% reduction from 100% Existing Standards scenario)

No change to Motocycles

Population: EMFAC2011 default; VMT: SCAG RTP adjusted

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Goods Movement Sources - NOx Emissions (Tons Per Day) -2032									
Source	Population	VMT (miles/day)	Baseline	Equal Share Target (-75% from 2023)	100% Existing Standards*	90% Cleaner Combustion Technologies**	ATP1 - 25% Zero / 75% Near-Zero	ATP2 - 50% Zero / 50% Near-Zero	ATP3 - 75% Zero / 25% Near-Zero
Light Heavy Duty Gas Trucks-1 (8501-10000 lb.)	350,806	14,536,676	7.82	2.74	4.58	4.58	3.44	2.29	1.15
Light Heavy Duty Gas Trucks-2 (10001-14000 lb.)	36,613	1,547,324	0.77	0.25	0.52	0.52	0.39	0.26	0.13
Medium Heavy Duty Gas Trucks (14001-33000 lb.)	29,088	1,128,000	0.71	0.27	0.45	0.05	0.03	0.02	0.01
Heavy Heavy Duty Gas Trucks (>33000 lb.)	2,038	188,000	0.93	0.21	0.84	0.08	0.06	0.04	0.02
Light Heavy Duty Diesel Trucks-1 (8501-10000 lb.)	112,978	4,531,254	4.73	2.41	2.31	2.31	1.73	1.15	0.58
Light Heavy Duty Diesel Trucks-2 (10001-14000 lb.)	37,402	1,496,746	1.61	0.8	0.87	0.87	0.65	0.43	0.22
Medium Heavy Duty Diesel Trucks (14001-33000 lb.)	100,084	4,998,000	5.42	1.25	5.31	0.53	0.40	0.27	0.13
Heavy Heavy Duty Diesel Trucks (>33001 lb.)	108,911	12,278,000	34.41	7.92	33.15	3.32	2.49	1.66	0.83
Total	**777,921**	**40,704,000**	**56.4**	**15.85**	**48.04**	**12.26**	**9.19**	**6.13**	**3.06**

Passenger Transportation Sources - NOx Emissions (Tons Per Day) -2032									
Source	Population	VMT (miles/day)	Baseline	Equal Share Target (-75% from 2023)	100% Existing Standards*	90% Cleaner Combustion Technologies**	ATP1 - 25% Zero / 75% Near-Zero	ATP2 - 50% Zero / 50% Near-Zero	ATP3 - 75% Zero / 25% Near-Zero
Light Duty Passenger	6,198,902	208,469,240	6.83	3.07	5.33	5.33	4.00	2.66	1.33
Light Duty Trucks-1 (up to 3750 lb.)	774,282	26,511,038	1.91	1.09	1.08	1.08	0.81	0.54	0.27
Light Duty Trucks-2 (3751 to 5750 lb.)	2,220,575	80,214,386	4.48	1.93	3.13	3.13	2.35	1.57	0.78
Medium Duty Trucks (5751-8500 lb.)	1,881,310	62,155,336	6.82	3.00	3.09	3.09	2.32	1.54	0.77
Heavy Duty Diesel Urban Buses	8,234	882,829	7.85	2.59	0.54	0.05	0.04	0.03	0.01
Heavy Duty Gas Urban Buses	2,159	231,860	0.54	0.15	0.10	0.01	0.01	0.01	0.00
School Buses - Gas	1,890	67,874	0.05	0.02	0.01	0.00	0.00	0.00	0.00
School Buses - Diesel	4,808	165,524	1.07	0.43	0.30	0.03	0.02	0.02	0.01
Other Buses - Gas	7,924	297,772	0.37	0.12	0.22	0.02	0.02	0.01	0.01
Other Buses - Diesel	7,365	618,352	1.15	0.23	1.15	0.11	0.09	0.06	0.03
Motor Homes	113,494	1,308,532	0.92	0.92	0.75	0.08	0.06	0.04	0.02
Motorcycles	242,094	1,732,796	2.07	0.52	2.07	2.07	2.07	2.07	2.07
Total	**11,463,038**	**382,655,538**	**34.06**	**14.07**	**17.77**	**15.00**	**11.77**	**8.54**	**5.30**

Assumptions:

*100% Existing Standards:

(1) Vehicles w/ weight up to 14,000 lbs (PC, LDT1, LDT2, MDV, LHD1, LHD2): pre-2025 MY vehicles emit at 100% ACC phase-in emission level (2025-2032 MY fleet average)

(2) Vehicles w/ weight 14,000+ lbs (MHDT, HHDT, UBUS, SBUS, OBUS, MH): pre-2010 MY vehicles emit at **2010 emission level (2010-2032 MY fleet average)**

**90% Cleaner Combustion Technologies (100% Penetration of "Near-Zero" Technologies"):

(1) Vehicles w/ weight up to 14,000 lbs (PC, LDT1, LDT2, MDV, LHD1, LHD2): same as 100% Existing Standards scenario (100% ACC)

(2) Vehicles w/ weight 14,000+ lbs (MHDT, HHDT, UBUS, SBUS, OBUS, MH): linear reduction (90% reduction from 100% Existing Standards scenario)

No change to Motocycles in all scenarios except for Equal Share

Population: EMFAC2011 default; VMT: SCAG RTP adjusted

Baseline Scenario

- EMFAC2011 Default
  - Latest CARB Approved Model
  - Incorporates Truck and Bus Rule
- Baseline Inventories Provided in 2012 AQMP

Equal Share Scenario

- Overall NOx Reduction to Attain Air Quality Standards
- Targeted NOx Reduction
  - 2023 CY: 65% Reduction
  - 2032 CY: 75% Reduction from 2023 CY
    - 72% Reduction from Baseline for 2032 CY Goods Movement
    - 59% Reduction from Baseline for 2032 CY Pass. Trans.
- Off-Model Calculation

100% Existing Standards Scenario

- Vehicles up to 14,000 lbs. GVWR
  - 100% LEV III
  - 2025 MY to 2032 MY Average
- Vehicles Greater than 14,000 lbs. GVWR
  - 100% 0.2 g/bhp-hr NOx
  - 2010 MY to 2032 MY Average
- Off Model Calculation
- Results from Baseline:
  - 2023 CY: 33%/69% Reduction, Goods Movement/Pass Trans.
  - 2032 CY: 15%/48% Reduction, Goods Movement/Pass Trans.

90% Cleaner HD Fleet Scenario

- Relative to 100% Existing Standard
- Does not Affect Vehicles up to 14,000 lbs. GVWR
- Assumes HD Fleet at 0.02 g/bhp-hr NOx
- Off-Model Calculation
- Results from Baseline:
  - 2023 CY: 82%/74% Reduction, Goods Movement/Pass Trans.
  - 2032 CY: 78%/56% Reduction, Goods Movement/Pass Trans.

Advanced Technology Penetration Scenario

- Relative to 90% Reduction Scenario
- 25%, 50%, and 75% ZEV Penetration Scenarios
- Off-Model Calculation
- Results from Baseline:
  - 2023 CY-25%: 87%/79% Reduction, Goods Movement/Pass Trans.
  - 2023 CY-50%: 91%/85% Reduction, Goods Movement/Pass Trans.
  - 2023 CY-75%: 96%/91% Reduction, Goods Movement/Pass Trans.
  - 2032 CY-25%: 84%/65% Reduction, Goods Movement/Pass Trans.
  - 2032 CY-50%: 89%/75% Reduction, Goods Movement/Pass Trans.
  - 2032 CY-75%: 95%/84% Reduction, Goods Movement/Pass Trans

Scenario Assumptions – Off-Road

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2023 Scenarios

Goods Movement Sources	Remaining Emissions (tons/day)						
Source	2023 Baseline NOx	Equal Share Target (-65%)	100% Existing Standard	90% Cleaner Technologies (Potentially Feasible)[1]	ATP 1 - 25% Zero/ 75% Near-Zero[2]	ATP 2 - 50% Zero/ 50% Near-Zero[2]	ATP 3 - 75% Zero/ 25% Near-Zero[2]
Ocean Going Vessels[3]	28.51	9.98	13.27	8.80	8.80	8.80	8.80
Freight Locomotives	17.77	6.22	5.48	0.55	0.41	0.28	0.14
Cargo Handling Equipment	2.23	0.78	1.20	0.12	0.09	0.06	0.03
Harbor Craft[4]	5.89	2.06	1.62	1.39	1.39	1.39	1.39
Aircraft[5]	2.03	0.71	0.51	0.51	0.51	0.51	0.51
Total	56.42	19.75	22.07	10.20	9.92	9.76	9.59

[1] Shaded cells represent assumed 100% penteration of cleaner technologies

[2] ATP - Advanced Technology Penetration

[3] All Tier 3 with additional 90% control of auxiliary and boiler emissions at berth and anchorage

[4] 90% Cleaner Column shows - 20% of fleet emissions reduced by 70% through cleaner engines and hybridization

[5] Assumes 13% of total aircraft emissions from freight transport

Passenger Transportation	Remaining Emissions (tons/day)						
Source	2023 Baseline NOx	Equal Share Target (-65%)	100% Existing Standard	90% Cleaner Technologies (Potentially Feasible)[1]	ATP 1 - 25% Zero/ 75% Near-Zero[2]	ATP 2 - 50% Zero/ 50% Near-Zero[2]	ATP 3 - 75% Zero/ 25% Near-Zero[2]
Ocean Going Vessels (Cruise Ships)[3]	3.54	1.24	1.32	0.99	0.99	0.99	0.99
Passenger Locomotives	4.46	1.56	1.07	0.11	0.08	0.06	0.03
Harbor Craft (Ferries)[4]	3.32	1.16	0.88	0.57	0.57	0.57	0.57
Aircraft[5]	13.59	4.76	3.40	3.40	3.40	3.40	3.40
Total	24.92	8.72	6.67	5.07	5.04	5.01	4.98

[1] Shaded cells represent assumed 100% penteration of cleaner technologies

[2] ATP - Advanced Technology Penetration

[3] All Tier 3 with additional 90% control of auxiliary and boiler emissions at berth and anchorage

[4] 90% Cleaner Column shows - 20% of fleet emissions reduced by 70% through cleaner engines and hybridization

[5] Assumes 87% of total aircraft emissions from freight transport

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2032 Scenarios

Goods Movement	Remaining Emissions (tons/day)						
Source	2032 Baseline NOx	Equal Share Target (-75% from 2023)	100% Existing Standard	90% Cleaner Technologies (Potentially Feasible)[1]	ATP 1 - 25% Zero/ 75% Near-Zero[2]	ATP 2 - 50% Zero/ 50% Near-Zero[2]	ATP 3 - 75% Zero/ 25% Near-Zero[2]
Ocean Going Vessels[3]	27.33	7.65	19.71	13.19	13.19	13.19	13.19
Freight Locomotives	14.72	4.12	6.53	0.65	0.49	0.33	0.16
Cargo Handling Equipment	2.38	0.71	1.89	0.19	0.14	0.10	0.05
Harbor Craft[4]	6.68	1.53	1.94	1.26	1.26	1.26	1.26
Aircraft[5]	2.25	0.52	1.13	1.13	1.13	1.13	1.13
Total	53.36	14.54	31.19	16.39	16.12	15.91	15.70

[1] Shaded cells represent assumed 100% penteration of cleaner technologies

[2] ATP - Advanced Technology Penetration

[3] All Tier 3 with additional 90% control of auxiliary and boiler emissions at berth and anchorage

[4] 90% Cleaner Column shows - 50% of fleet emissions reduced by 70% through cleaner engines and hybridization

[5] Assumes 13% of total aircraft emissions from freight transport

Passenger Transportation	Remaining Emissions (tons/day)						
Source	2032 Baseline NOx	Equal Share Target (-75% from 2023)	100% Existing Standard	90% Cleaner Technologies (Potentially Feasible)[1]	ATP 1 - 25% Zero/ 75% Near-Zero[2]	ATP 2 - 50% Zero/ 50% Near-Zero[2]	ATP 3 - 75% Zero/ 25% Near-Zero[2]
Ocean Going Vessels (Cruise Ships)[3]	1.79	0.50	1.76	1.36	1.36	1.36	1.36
Passenger Locomotives	4.91	1.38	2.12	0.21	0.16	0.11	0.05
Harbor Craft (Ferries)[4]	3.30	0.76	0.92	0.6	0.60	0.60	0.60
Aircraft[5]	15.06	3.46	7.53	7.53	7.53	7.53	7.53
Total	25.06	6.10	12.32	10.00	9.95	9.90	9.85

[1] Shaded cells represent assumed 100% penteration of cleaner technologies

[2] ATP - Advanced Technology Penetration

[3] All Tier 3 with additional 90% control of auxiliary and boiler emissions at berth and anchorage

[4] 90% Cleaner Column shows - 50% of fleet emissions reduced by 70% through cleaner engines and hybridization

[5] Assumes 87% of total aircraft emissions from freight transport

Ocean Going Vessels

(Goods Movement and Passenger)

- *100% Existing Standard*
  - All Visits from Ships with IMO Tier 3 Engines
- *90% Cleaner Technologies*
  - All Visits Tier 3
  - Additional 90% control of Auxiliary Engines and Boilers at berth and anchorage
- *ATP 1/2/3* – No Additional Reductions

Locomotives

(Freight and Passenger)

- *100% Existing Standard*
  - All Tier 4 Locomotives
- *90% Cleaner Technologies*
  - All Locomotives 90% Cleaner than Tier 4
- *ATP 1/2/3*
  - 25/50/75% of Fleet at Zero Emissions
  - 75/50/25% of Fleet at 90%Cleaner than Tier 4

Cargo Handling Equipment

- *100% Existing Standard*
  - All Tier 4 CHE
- *90% Cleaner Technologies*
  - All CHE 90% Cleaner than Tier 4
- *ATP 1/2/3*
  - 25/50/75% of Fleet at Zero Emissions
  - 75/50/25% of Fleet at 90%Cleaner than Tier 4

Harbor Craft

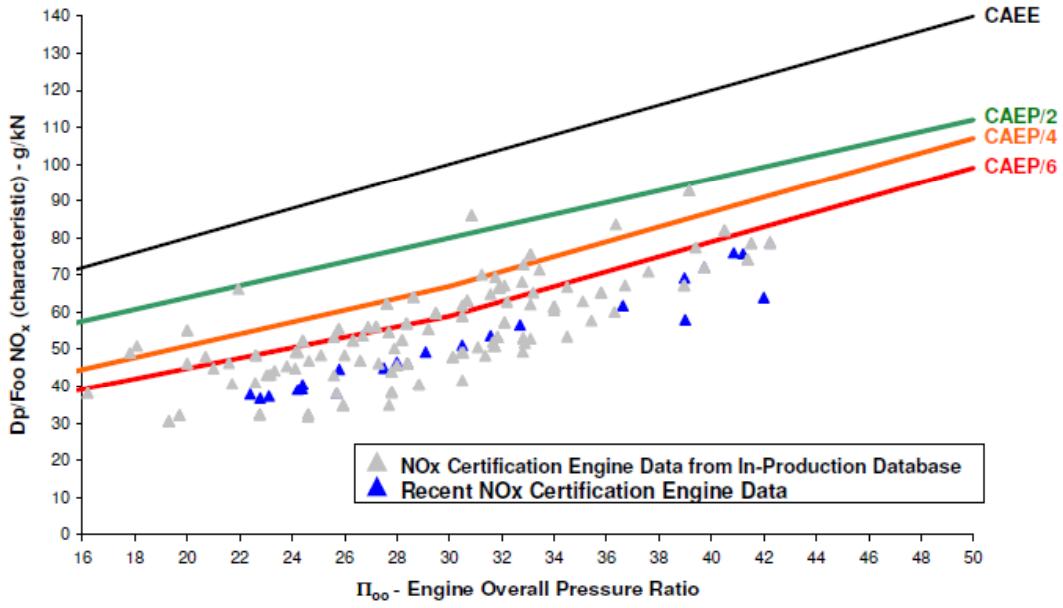
(Goods Movement and Passenger)

- 100% Existing Standard
  - All Tier 4 Tugs and Ferries
  - All Others at Tier 3
- 90% Cleaner Technologies
  - 2023 – 20% of Vessels' Emissions Reduced 70%
  - 2032 – 50% of Vessels' Emissions Reduced 70%
  - Reductions from Hybridization and Cleaner Engines
- ATP 1/2/3 – No Additional Reductions

Aircraft

(Freight and Passenger)

Engine certifications relative to CAEP stringency



- Cleanest Aircraft Operate in District
- Approximate 50% Reduction