Fuels Institute

Index of Slides with Titles

SLIDES BY TOPIC

SLIDE TITLES IN ORDER OF APPEARANCE

EXECUTIVE SUMMARY

PROJECT REPORT

Telecommuting

Vehicle Electrification

15. Subsidies and charging network are critical PEV uptake drivers in short-med term; ZEV mandate and charging network in long term
16. Subsidies, ZEV mandate and charging infrastructure create a network effect to directly drive PEV uptake
17. PEVs offer slightly lower lifecycle emissions compared to ICEs; renewable energy use will further reduce lifecycle emissions for PEVs
18. If PEVs account for 60% new vehicle sales by 2040, results in ~ 50% reduction in avoided lifecycle GHG CO2 emissions w.r.t 2020 sales
19. 60% PEV uptake (new vehicle sales) scenario in 2040 results in ~85M PEV parc, potentially displacing gasoline consumption by ~30B gal's
20. Subsidies are vital for PEV sales – in California PEV buyers survey, ~70% ranked subsidies a key factor in their purchase decision
21. Georgia's PEV demand dropped by ~60% after $5k state rebate was rescinded; similar trends observed in other countries, notably China

Fuel Economy Standards

22. Scaling back of CAFE standards will affect emissions reduction for ICE vehicles drawing higher reliance on PEVs for emissions reduction
23. SAFE rule finalized in 2020 drastically reduces fleet fuel economy targets and emissions reduction impact compared to earlier targets

Biofuels Policies

24. LCFS (California and Washington) and RFS (federal) mandates have had varying success
25. LCFS is more effective than RFS however is aided by EV uptake; if EVs plateau, some other alt fuel disruption needs to occur to meet LCFS
26. EPA waivers for Renewable Fuel Standard (RFS) show significant lag in meeting original targets
27. CARB projections estimate ethanol, biodiesel, renewable diesel and biomethane to be key drivers alongside electrification to meet targets
28. Increased EV penetration is the key driver to comply with LCFS targets. Alternative fuels only enablers based on current technology
29. Fuel economy is lower for alternative fuels and blends compared to baseline gasoline and diesel fuel

Cleaner Trucks Initiative

30. Cleaner Trucks Initiative (CTI) still in proposal phase with expected impact in 2025+ timeframe
31. CTI aims to lower NOX emissions with focus on lower-load conditions; CTI still in proposal phase with expected impact in 2025+ timeframe
32. Diesel trucks meeting 0.6 g/mile target across all load conditions reduces NOX emissions of commercial vehicle parc by >65%

TCI and Carbon Pricing

33. TCI and carbon pricing may have direct limited impact on emissions reduction given the limited nationwide momentum these may have
34. TCI is estimated to contribute ~1% - 6% of the overall target, with rest achieved through electrification and fuel efficiency improvement
35. Revenue from allowance sales to be invested by TCI signatory regions to support low-carbon transportation initiatives
36. Numerous carbon pricing legislation has been proposed however distribution of revenues are not targeted towards transportation

Low Emission Zones/ICE Bans/Congestion Pricing/Mobility

37. Movements such as LEZ/ICE bans, congestion pricing and mobility initiatives are localized and limited to urban regions
38. LEZ deployment in LA county based on EU model potentially reduces NOX by >10% and CO2 by ~4%-8% based on implementation scenario
39. Emission reduction benefits of congestion pricing are localized and sustained through clean public transport. Limited impact nationally
40. Congestion pricing has a high cost of access and also yields high gains in localized emissions reduction
41. Shared & autonomous mobility impacts U.S. parc with vehicle ownership per thousand reducing ~10% compared to 2019 value

APPENDIX 1 – PROJECT REPORT ADDENDUM

Light duty vehicles powertrain mix and parc scenarios and criteria emissions impact

43. Ricardo reviewed multiple studies to generate PEV penetration outlook scenarios
44. U.S Vehicle Parc low-to-high- scenarios based on impact of vehicle private ownership vs shared mobility and autonomous vehicles
45. Current EPA emission standards (Tier -3) impact model years 2017-2025, with fleetwide adoption mandated by 2025
46. Ricardo used following assumptions for estimating U.S. light duty vehicles 2040 parc NOX and PM2.5 emissions
47. ~67% reduction in parc NOX emissions by 2040 from vehicle retirement. Additional ~23% reduction from high EV uptake
48. ~70% reduction in parc PM2.5 emissions by 2040 from vehicle retirement. Additional ~26% reduction from high EV uptake

Medium and heavy duty commercial vehicles powertrain mix and parc scenarios

50. Ricardo reviewed multiple studies to generate medium and heavy duty trucks PEV penetration outlook scenarios and impact on parc
51. U.S. Medium Duty EV Penetration Scenarios
52. U.S. Medium Duty Parc Scenarios
53. U.S. Heavy Duty EV Penetration Scenarios
54. U.S. Heavy Duty Parc Scenarios

Cost assessment methodology & assumptions used to project Movement impact until 2040

56. Following general assumptions were made for projecting impact of Movements in 2040
57. Select movements cost impact assessment methodology is provided below.

Biofuels

59. A positive but limited impact expected based on alternative fuels. Electrification will be the main driver to achieve expected reductions
60. Higher incremental cost of $0.6-$0.8 estimated per gallon of transportation fuel to meet LCFS targets
61. Limited and a lower impact on GHG emissions from RFS compared to LCFS on a normalized basis if RFS continues with current format
62. RFS levies a lower incremental cost per gallon of fuel compared to LCFS; expected to continue if RFS implementation does not change
63. TOC

64. Trucks meeting 0.6 g/mile target across all load conditions reduces NOX emissions of new vehicles by ~80%
65. Fuel economy could potentially improve or reduce by 1% - 2% based on technologies used to comply with emissions targets

Cleaner Trucks Initiative/TCI/Carbon Pricing

67. Average incremental yearly fuel costs from TCI and carbon pricing are not significant enough to shift consumer behavior
68. Both TCI and carbon pricing are reliant on technology breakthrough in PEVs to impact vehicle demand compared to other Movements
69. Impact on fuel economy from TCI and carbon pricing is heavily reliant on uptake of fuel efficient vehicles

APPENDIX 2 – MOVEMENT 101 – SUMMARIES OF INDIVIDUAL INITIATIVES

Telecommuting

72. Telework Enhancement Act of 2010 mandates each federal agency to establish a telecommuting policy and maximize it where applicable
73. EU telework agreement provides autonomy to each member state on implementation; Canada telework policy limited to federal positions

Subsidies

74. Many states are promoting alternative adoptions by providing extra incentives, tax credits and registration fee reductions (1/2)
75. Many states are promoting alternative adoptions by providing extra incentives, tax credits and registration fee reductions (1/2)
76. Several countries offer subsidies to drive EV uptake; EU considering VAT exemption for EVs to drive demand post COVID-19

ZEV Mandate

77. ZEV mandate requires OEMs selling vehicles in signatory states to sell a percentage of vehicles to be xEVs to meet credit requirements
78. China's NEV policy mandates manufacturers to meet incremental credit based requirements through xEV sales

Charging Infrastructure

79. EV Freedom Act is a federal level legislation, still under legislative process, that seeks to address EV charging infrastructure issues
80. NJ's S2252 bill passed (01/2020) mandates establishing a statewide public charging system to support 330k PEVs by 2025
81. Norway and France have charging infrastructure rollout legislation. Other regions have directives to support increased EV adoption

CAFE

82. CAFE includes targeted incentives for advanced technologies that promote fuel economy improvements and GHG reductions
83. Japan, China, and South Korea have fuel economy standards similar to CAFE standards in U.S.

Biofuels

84. Increased difficulty in meeting standards impacts the cost of compliance, resulting in significant financial burden for refiners
85. EU has assigned individual national targets in order to achieve 80 - 95% GHG emission reduction by 2050
86. Low Carbon Fuel Standard (LCFS) is designed to reduce the lifecycle carbon intensity (CI) of transportation fuels
87. Fuels Quality Directive (FQD) will be phased out after 2020 as decarbonization of transport fuels will be addressed in RED II

Cleaner Trucks Initiative

88. Cleaner Truck Initiative in proposal stage and expected to impact in 2025+; aims to target NOX emissions reduction in low-load operation

Transportation Climate Initiative/Carbon Pricing

89. Transportation Climate Initiative seeks to reduce transportation emissions and develop a clean energy economy in 13 regions in U.S.
90. Transportation Climate Initiative (TCI) is a still-in-work “cap & invest” initiative that is estimated to start in 2022
91. Ten states currently pricing carbon with impact limited mostly to power gen sector. Legislation under review for nationwide adoption
92. Energy Taxation Directive (ETD) establishes minimum duty rates that States must apply to energy products for fuel, transport, & electricity
93. Multiple legislation and trading schemes are in place around the world to mitigate GHG emissions

Vehicle Use Types/Restrictions/Low or Zero Emission Zones

94. No LEZs in U.S cities. New Jersey only state mandating >85% of new vehicle sales by ZEVs by 2040; other states proposals in draft/rejected
95. Major cities worldwide have implemented low emission zones to improve air quality
96. Proposals outlined by major car production and sales regions to ban combustion engine cars beginning in 2030

Congestion Pricing

97. Zone based congestion pricing legislation adopted only by New York City in U.S.; feasibility studies underway in other regions
98. London, Stockholm, Milan and Singapore are few prominent examples of cities that implemented cordon congestion pricing

Shared Mobility/Connected Autonomous

99. With steady growth, states will adopt further measures to formally incorporate Shared Mobility into their overall transport system
100. Federal level regulation yet to be implemented for autonomous vehicles; two acts under legislative review
101. EU working to harmonize rules as multiple legislation in place & will likely cause disruption as vehicles drive on diverse regions road systems
102. TOC

Vehicle Retirement Programs

103. California offers Consumer Assistance Program (CAP), an incentive program to retire older high polluting vehicles
104. California CAP support in 2019 limited to ~3% of total new vehicle registrations in California market and ~0.02% of U.S. parc
105. France and Romania run incentive programs for replacing eligible older vehicles with lower emitting new/used vehicles

Tolls

106. FAST act approved in 2015 amended Section 166 of title 23, U.S.C.; grants bodies authority to convert HOV to HOT lane
107. Cost of running the car, battery life, safety, purchase price are the key drivers influencing consumer's BEV purchase
108. xEV HOV incentive is an xEV adoption factor in some states and not in other. Studies are inconclusive on HOV access as key purchase criteria

Parking Benefits

109. Parking incentives in Connecticut, California etc. aim to encourage people to reduce GHG emissions and use EV for transportation
110. Norway is reducing xEV parking incentive in a staggered manner to curb traffic congestion from increased xEV penetration

Appendix 3 – Summary of Research

Telecommuting

113. Studies opinions vary on impact of telecommuting of fuel savings ranging from no impact to ~$2B per year
114. Additional studies reviewed also found that telecommuting has a net positive impact on fuel savings
115. Studies estimate telecommuting reduces GHG emissions from ~4 million tonnes to 7 .4 millions tonnes
116. Post COVID-19, telecommuting and its impact on GHG emissions may be assessed for future telecommuting strategy roll-out (1/2)
117. Post COVID-19, telecommuting and its impact on GHG emissions may be assessed for future telecommuting strategy roll-out (2/2)

Subsidies, ZEV mandate, Charging network

119. Opinions diverge on impact of subsidies on xEV demand ranging from no impact to ~30% of EV sales a direct result of subsidies
120. Other evaluated studies also found federal and state incentives along with charging infrastructure are critical drivers for xEV adoption
121. EIA found that state-level ZEV incentives was not well correlated with market share of ZEVs and PHEVs in 2016
122. Studies indicate even in Europe subsidies and incentives are key factors influencing consumer purchase behaviors
123. ZEV mandate applies to ~30% of national new vehicle fleet; most estimates range at ~$400-$500* incremental cost per vehicle
124. Studies estimate lifetime fuel savings of ZEVs range from ~$5,000 to ~$15,000 per vehicle
125. Argonne cradle-to-grave lifetime analysis forecasts MY25 ZEV emissions to be at least 50% less compared to a MY25 ICE vehicle

126. Impact of ZEV mandate must be assessed considering BEV sales within California are driven by customer demand for Tesla Model 3
127. Studies found significant correlation between EVSE network and PEV uptake. 2X impact on uptake per $ for EVSE compared to subsidies
128. Additional studies reviewed also found a positive correlation between strong EVSE network and EV uptake
129. ICCT study– In 2016, regions with high EV market uptake had correspondingly high charge points per million population
130. Major EV markets continue to invest in charging infrastructure
131. In Europe relationship between public charging infrastructure and EV uptake varies based on availability of home charging and use cases
132. By end 2019 U.S. had installed public base of 78,000 L2 and DC fast charge public with ~18 PEVs per plug
133. California accounts for ~1/3rd of U.S. EVSE network; has 28 PEVs per plug
134. District of Columbia accounts for ~6% of U.S. EVSE network; has 5 PEVs per plug

CAFE Standard

136. Cost estimates to meet 2025 CAFE compliance range from $570 per vehicle to >$3,000 per vehicle
137. Studies estimate lifetime fuel savings impact of CAFE varies between ~$800 to ~$1,400 per vehicle
138. Variability in pricing considered for cost of carbon influences emissions reduction impact for each analysis
139. Proposed SAFE predicts positive impact on vehicle demand and IU study indicates negative impact from existing CAFE rules

Biofuels: Low Carbon Fuel Standard (LCFS) and Renewable Fuel Standard (RFS)

141. Low Carbon Fuel Std. (LCFS) and Cap and Trade (C&T) projected to save cum. ~$8 billion by 2025 in social cost of avoiding carbon emission
142. LCFS and Cap-and-Trade estimated to result in cumulative savings of ~$7B by 2025 from decreased petroleum dependency
143. ~$2B in incremental cost in 2017 to fuel refiners from California's LCFS and Cap-and-Trade program; cost expected to be >$9B by 2030
144. Renewable Fuel Standard (RFS): (1/2)
145. Renewable Fuel Standard (RFS): Annual volume standards that have been finalized for 2010 to 2020 (2/2)
146. Net GHG emissions reduction from RFS mandate is <5% compared to baseline of standard gasoline and diesel fuel use
147. Cost-benefit equation for consumers choosing std. ethanol-based vehicles is neutral to slightly negative
148. Industry is incurring combined $5-20B annual cost to comply with RFS mandate or purchase Renewable ID numbers (RINs)

Carbon pricing and Transportation Climate Initiative (TCI)

150. Revenue from allowance sales to be invested by TCI signatory regions to support low-carbon transportation initiatives
151. Estimated end user incremental fuel cost could range between $2B - $5.6B in 2032 based on TCI cap reduction targets
152. TCI GHG emissions impact may be only be 1% - 6% if TCI analysis reference case assumptions hold true, and limited to max of 19%

153. Fuel savings impact may range from ~$1B - $15B in fuel savings depending on net impact of TCI
154. Countries in Europe tax carbon at varying levels of jurisdiction with cost ranging from ~$1 – >$100 per ton
155. Carbon Tax Rates, Share of Covered Greenhouse Emissions, and Year of Implementation (as of 2019)
156. Impact of carbon tax on gasoline price appears moderate, however that on natural gas and coal prices appears significant
157. 2020 marked with Asia/Pacific region leading GHG emissions coverage through carbon pricing initiatives
158. Europe leads in both the steepest carbon tax pricing as well as revenue generation through taxation
159. Carbon revenue use varies globally with a notable amount being spent on environmental and climate related projects

Low Emission Zone (LEZ) / ICE bans, Congestion pricing and Mobility initiative

161. First enacted in 1992, EU emission controls set limits for air polluting nitrogen oxides (NOx) and particulate matter (PM) from engines
162. Diesel vehicles not meeting Euro 4 are not allowed in majority LEZs, whereas less stringent for gasoline vehicles (meeting Euro 1 allowed)
163. LEZ implementation results in ~5% - 10% reduction in NOX and PM emissions based on stringency, exemptions and enforcement
164. Congestion pricing in New York (limited to Central Business District) is expected to cost pass car commuters $6 - $12 per day
165. Congestion pricing in NYC estimated to reduce GHG emissions by ~1M tonnes i.e. ~6 - 7% of total transportation emissions in NYC
166. London congestion pricing scheme estimated to have reduced vehicle volume by ~35% compared to year 2000 level
167. Near term, consumers use mobility services in conjunction with private and public transport. Reduced vehicle ownership 2030+