NRDC
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California Transportation Wedge Analysis: 80% Reductions by 2050

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ZEV Scenario Analysis for Light Duty Vehicle

Background:

- California's AB32 requirements (returning to 1990 levels by 2020)
- California's 80% reduction goals by 2050.
- Transportation sector will need to be consistent with these overall goals
- What are the vehicle, fuel, and VMT policies that will be needed?
- What are the ranges of ZEV and Enhanced AT PZEV volumes (e.g. BEVs, FCV, PHEVs)

Background on Analytical Efforts

NRDC California Transportation Stock Model (CATSM)

- Structure: In-house model that replicates ARB's EMFAC vehicle stock model
- Coverage: Covers all on-road vehicle categories over MY1965 to 2050
- Standards: Incorporates Pavley vehicle GHG emission standards and LCFS requirements.
- Analysis: Allows for vehicle, fuel, and VMT scenarios to be analyzed
- Not an economic choice model

Background on Analytical Efforts

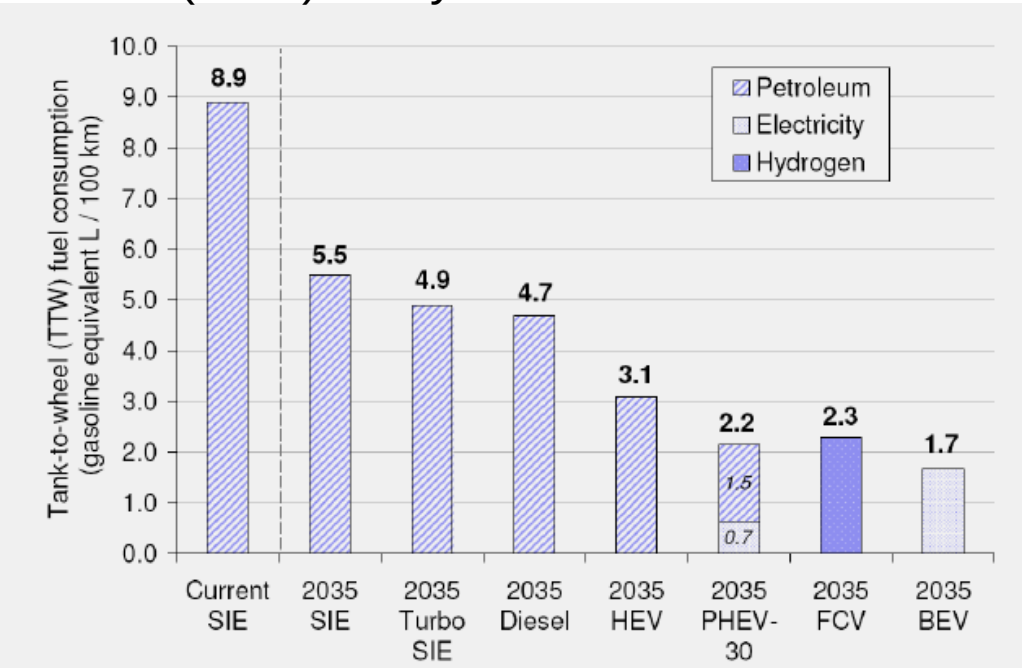
- Several different studies have been performed to evaluate potential California transportation sector emission reductions
- All studies have evaluated 80% reduction scenarios, consistent with the State climate goals
- Differing assumptions on biofuel use, VMT reductions, and fuel economy
- All include significant use of plug-in electric vehicles and fuel cell vehicles.

Analysis	NRDC	CARB	UC Davis	CEC	CEC
Contact	Simon Mui	Joshua Cunningham	Chris Yang, Joan Ogden	Tim Olson	Peter Ward
Model	CATSM	CA VISION	LEVERs	VISION	VISION
Purpose	ZEV, Pavley	ZEV, Pavley	Academic/ CalCEF	AB1007	AB118
Scope	On-road vehicles	On-road + others	All Categ-ories	LDV, HDV	LDV

3x Improvement in Vehicle Fuel Economy Can be Achieved by 2050

- Committee from National Academies study (2008) found:
  - "Evolutionary improvements in current gasoline-electric hybrids could reduce fuel consumption and GHG emissions per mile…nearly 70% by 2050 compared to today's conventional gasoline vehicles."

MIT (2008) Study: "On the Road in 2035"

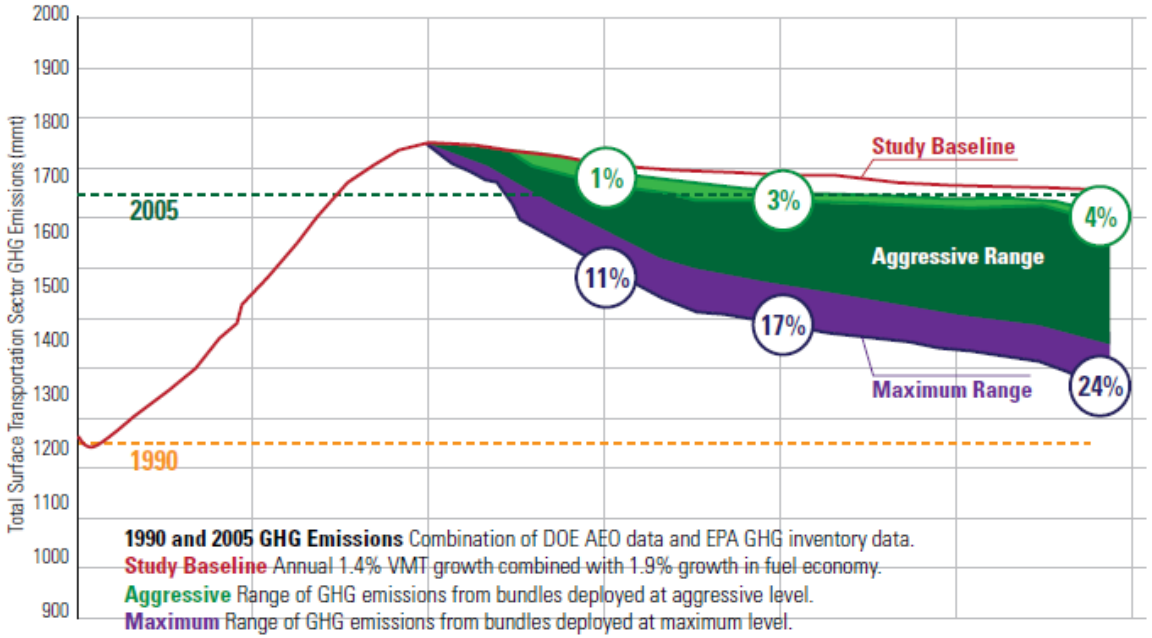


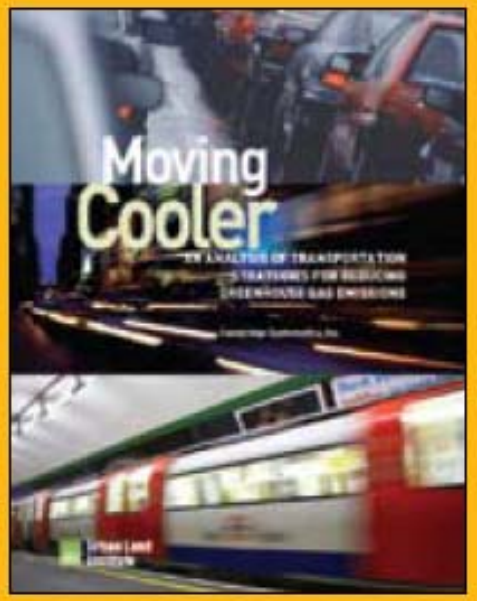
* NAS (2008), "Transitions to Alternative Transportation Technologies – A Focus on Hydrogen"

Improved travel efficiency will be needed to reduce VMT significantly by 2050

- SB375 - developing sustainable, healthy communities and providing greater transportation options
- Potential reductions assessed based on inputs from Moving Cooler (2009) study, Growing Cooler (2008), and Reid Ewing's analysis using California inputs

Greenhouse Gas Emission Reduction Range (Aggressive and Maximum Deployment): 2010 to 2050





Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions shows that strategies to improve travel efficiency, such as better community design paired with public transit and smarter traffic management, can have a dramatic effect on reducing U.S. oil consumption.

Low carbon fuels are critical to meeting our overall climate and energy security goals

- LCFS ensures that truly low carbon fuels are incentivized and developed at the pace and scale needed in a fuel neutral, performance-based manner
- Biomass availability and assumptions consistent with National Academies (2009) study that evaluates resource potential for 2020.
  - 420 million tons of non-food based biomass currently
  - 550 million tons in 2020
- Likely conservative for 2050 if cover and rotation crops are included, new fuels like algae-based fuels are commercialized, and yield increases beyond 2020.

Good biofuels versus bad biofuels: The best biofuels come from sustainable sources such as triticale (above left), a biomass grown as a winter crop. Bad biofuels can clearcut forests and demolish landscapes (above right).

* NAS (2009), “Liquid transportation fuels from coal and biomass.”

80% reduction scenarios for Light Duty Vehicles: Implications for the ZEV program

Clean Vehicles

"Achievable Targets" Case		*"Missed Targets" Case*
2016:	250 g CO_2/mi (35.5 mpg)*	250 g CO_2/mi (35.5 mpg)
2020:	211 g CO_2/mi (42 mpg)	234 g CO_2/mi (38 mpg)
2030:	162 g CO_2/mi (55 mpg)	197 g CO_2/mi (45 mpg)
2050:	111 g CO_2/mi i (80 mpg)	162 g CO_2/mi (55 mpg)

Travel Efficiency

- Smart Growth policy bundles, transit investments (pricing strategies not included)
- 11% to 32% reduction in per capita VMT (baseline case: 25%)

Low Carbon Fuels

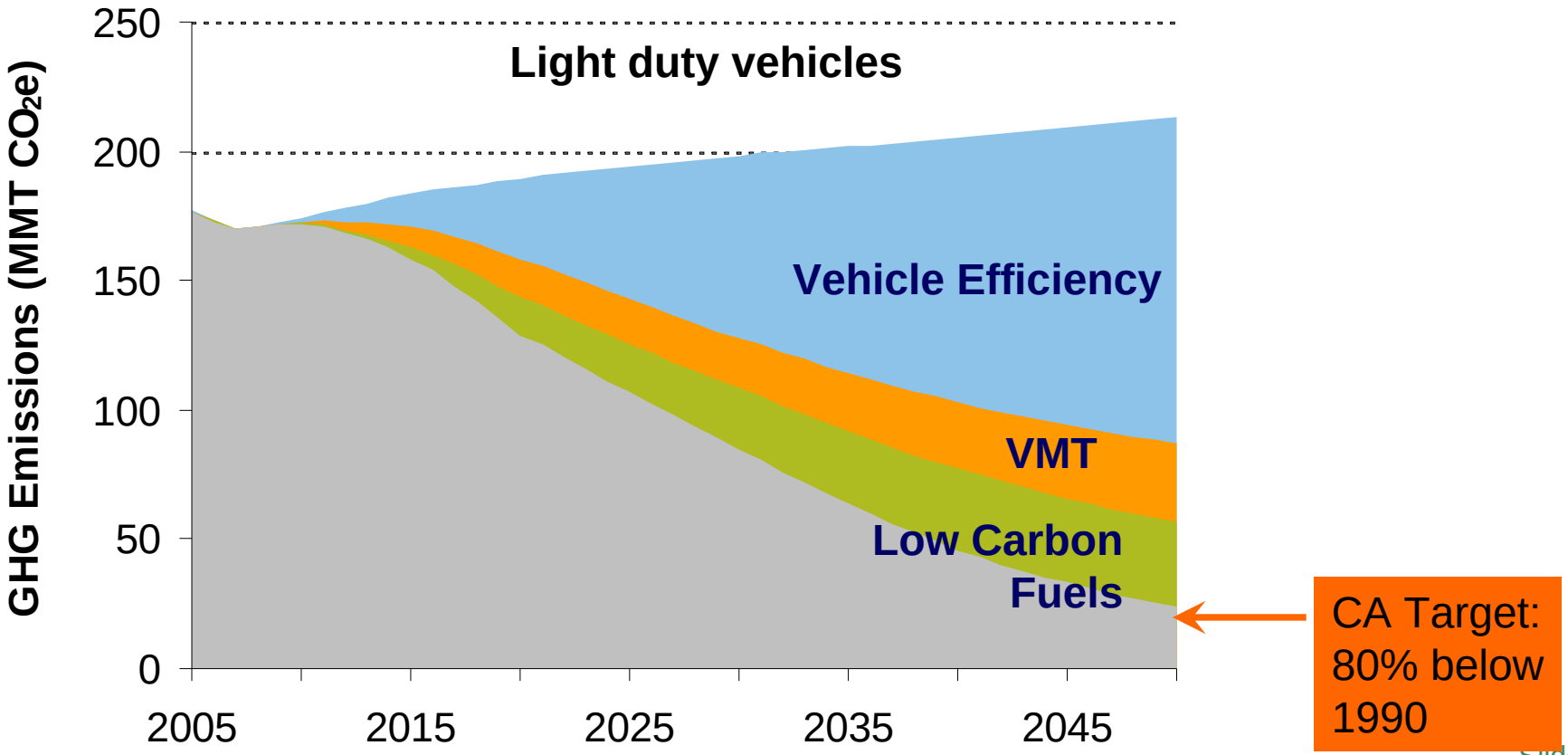
- Very conservative 1.5 billion gallons of biofuels (gasoline-equivalent) for LDV category (2.25 billion gallons of ethanol)
- 80% reduction in electricity carbon intensity by 2050

* Conversion based on 8.887 kg CO_2 per gallon gasoline

80% reduction scenarios for Light Duty Vehicles: Implications for the ZEV program

"Achievable Targets" Case

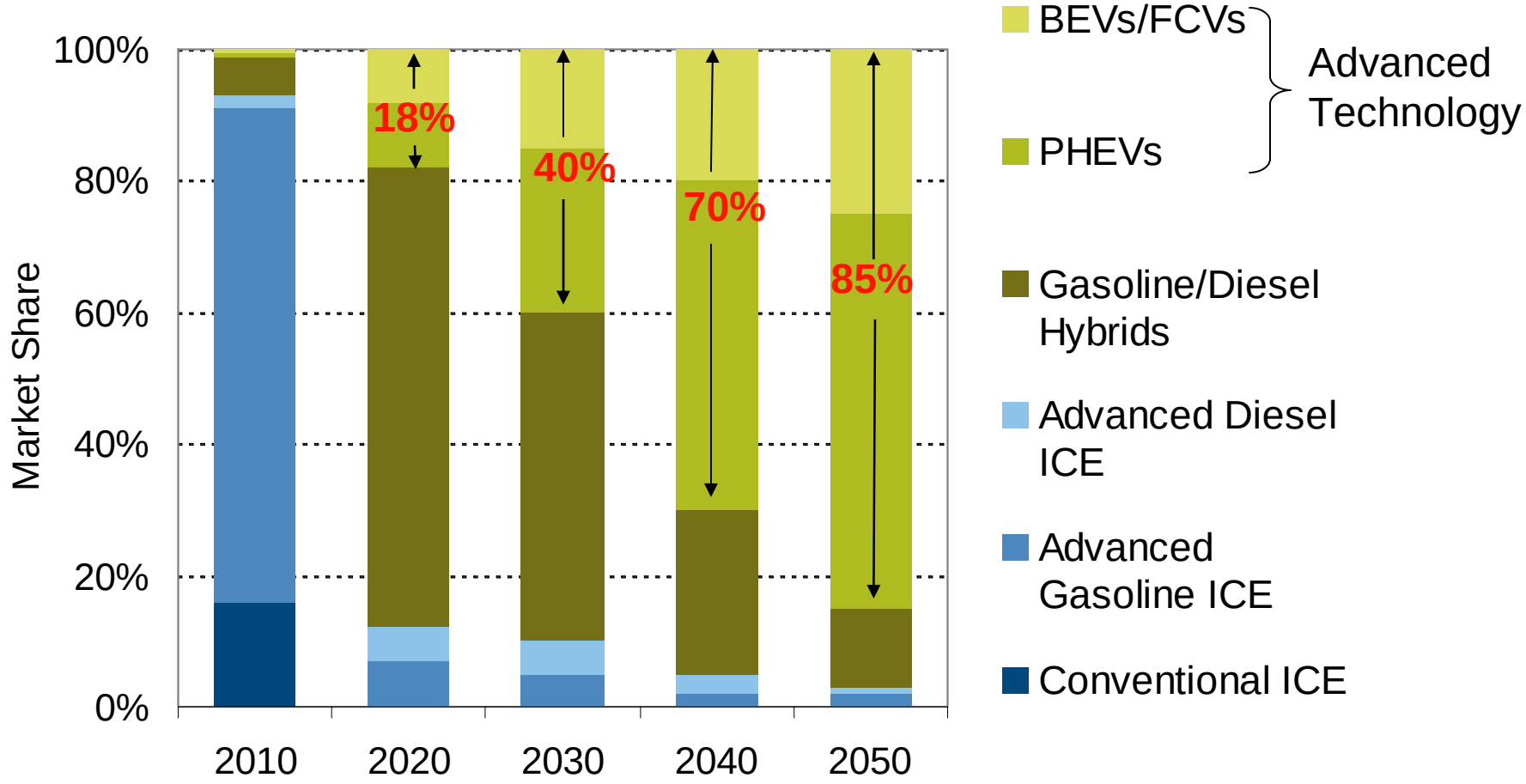
- 111 g CO_2/mile (80 mpg gasoline)
- 25% reduction in per capita VMT (-32% VMT versus BAU)
- Fuel carbon intensity decreased by 45%. (Constraint at 1.5 billion gge of biofuel)



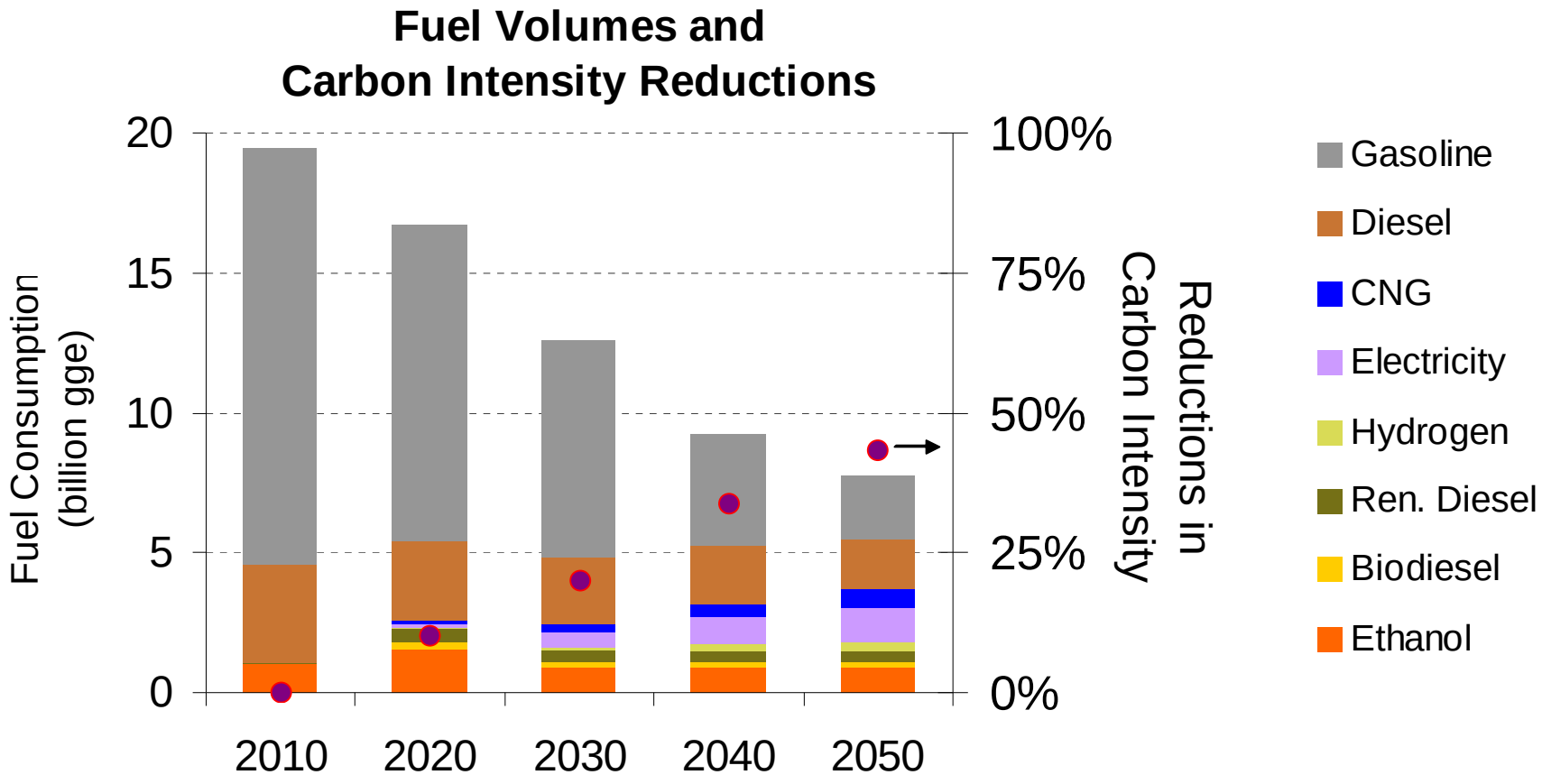
By 2020: Conventional hybrids, plug-in hybrids, and pure ZEVs will be needed in significant numbers

"Achievable Targets" Case

→ Implies significant hybridization as well as electric vehicle technologies by 2020



Significant amounts of cleaner, low carbon fuels will be needed

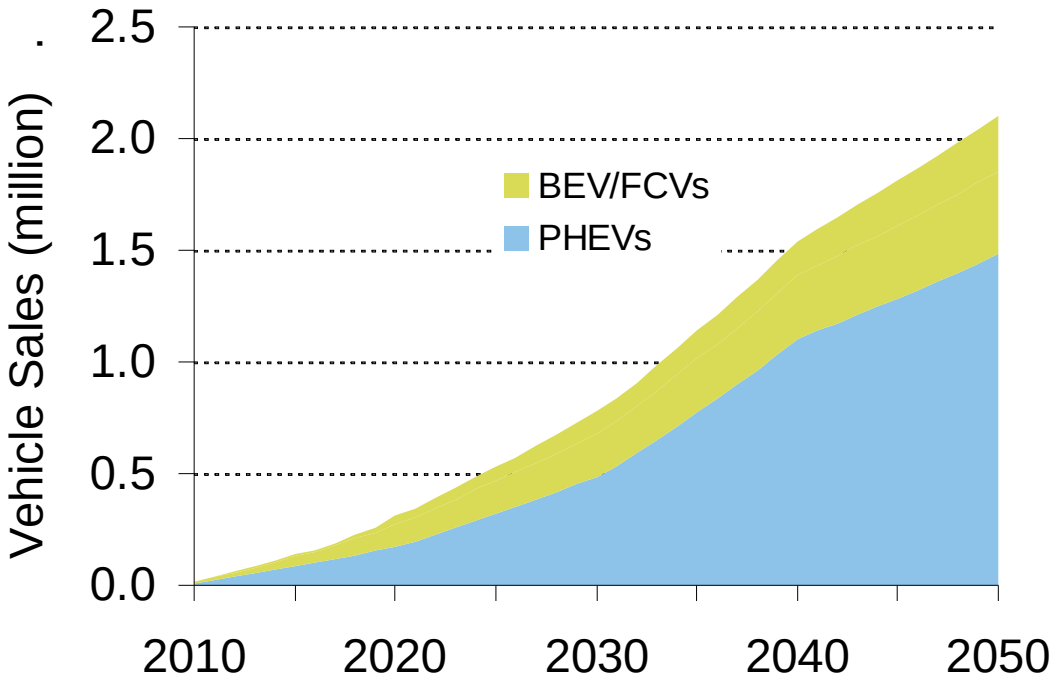


Pure ZEVs and Enhanced AT PZEVs

“Achievable Targets” Case

	2015	2020	2025	2030
PHEV	5.3%	10.0%	17.5%	25.0%
ZEV	3.3%	8.0%	11.5%	15.0%
PHEV	84,968	172,871	320,180	487,742
ZEV	52,680	138,297	210,404	292,645

- A low initial deployment places a greater burden in later years to increase sales rapidly (crash finish)
- Even with aggressive but achievable improvements in all three legs, significant sales of ZEVs and Enhanced-AT PZEVs are necessary between 2015 to 2025 to achieve the 2050 target.

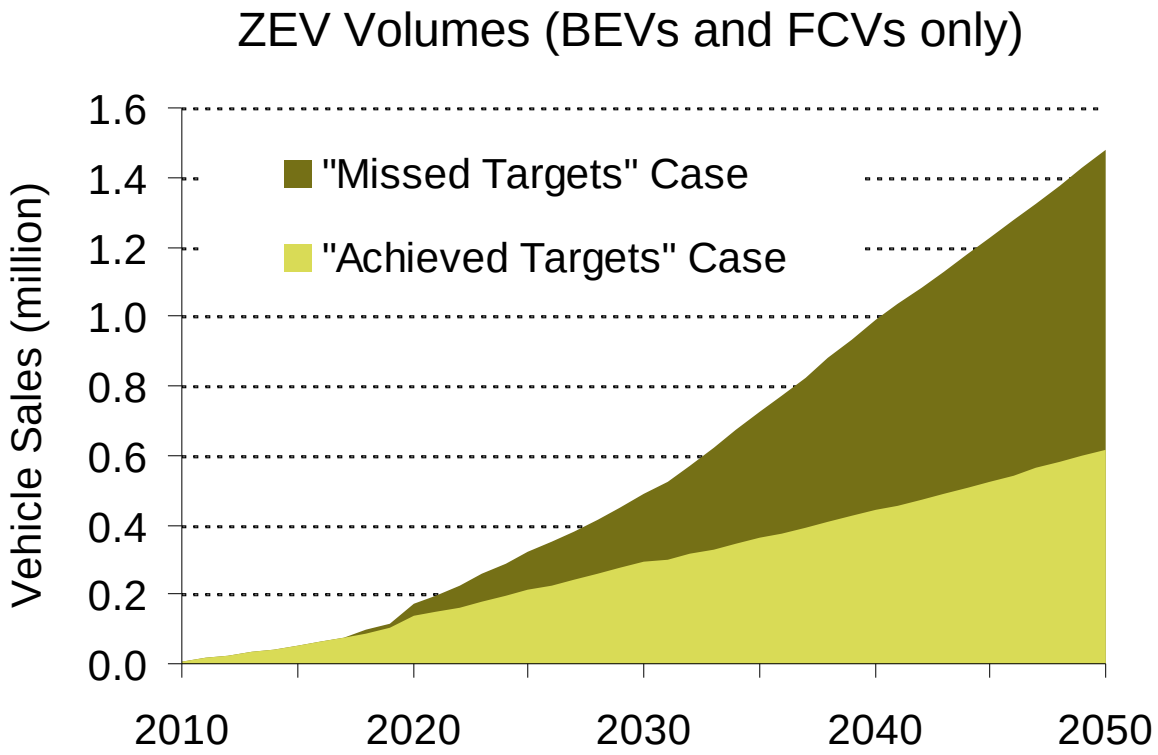


“Missed Targets” Case

- “What-If” scenario showing the need for a greater population of ZEVs and PHEVs if fuel efficiency targets are missed.
  - What-if industry misses targets for 2020, 2030, 2050 reaching 162 g CO_2/mile by 2050 (55 mpg) instead of 111 g CO_2/mile (80 mpg).
  - State and MPOs do not implement aggressive VMT reduction policies
- Deficit in cumulative emission reductions (2010 to 2050) of 264 MMT CO_2e versus baseline case.
  - More VMT somewhat offset by significant electrification by 2050
- Higher ZEV volumes needed to make up deficit

“Missed Targets” Case

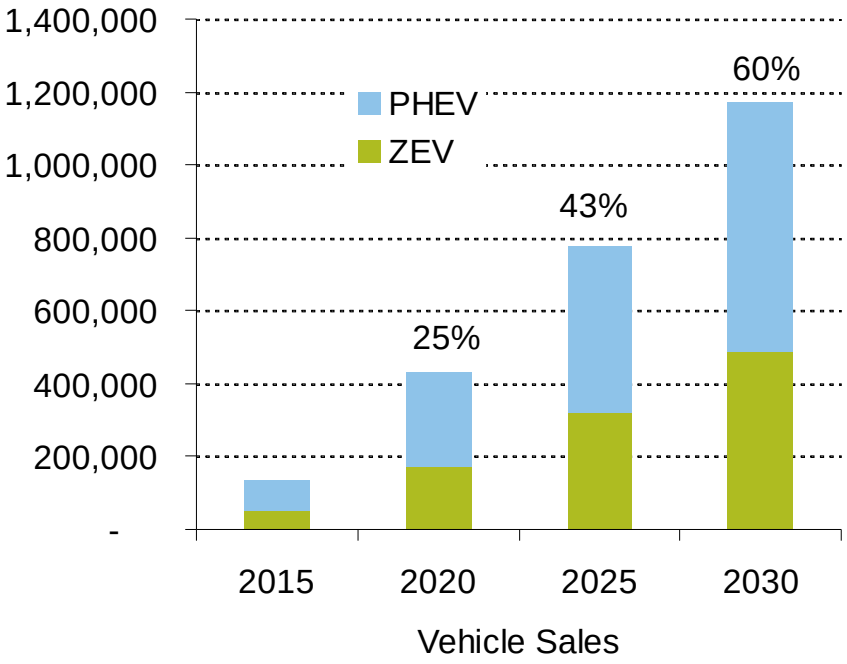
- If fuel efficiency targets (GHG vehicle standards) are missed, significantly greater ZEV volumes needed (in addition to more rapid deployment of PHEVs)



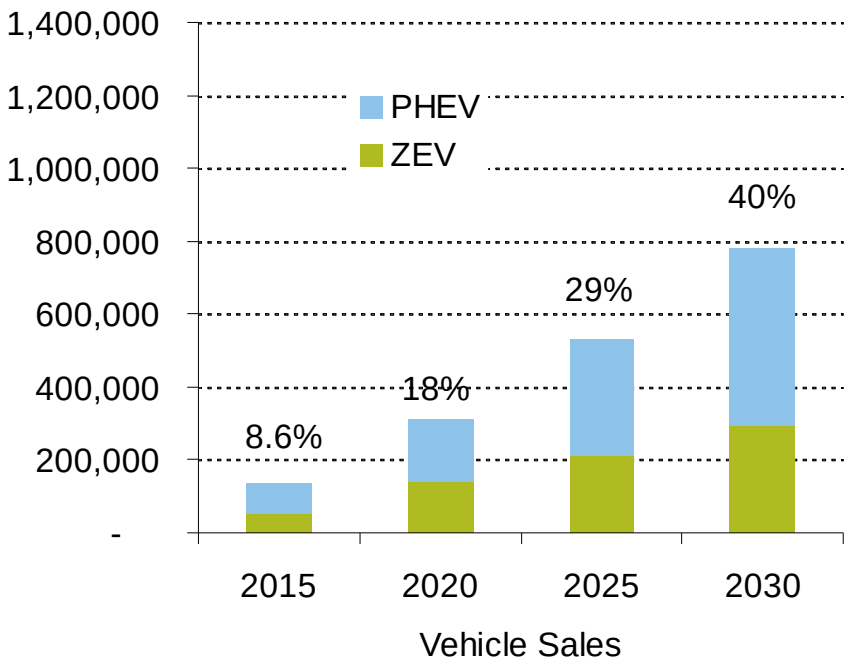
Comparison between Cases

- Both scenarios show rapid introduction of ZEVs and Enhanced-AT PZEVs. Scenarios are similar except for a five year window of delay

"Missed Targets" Case

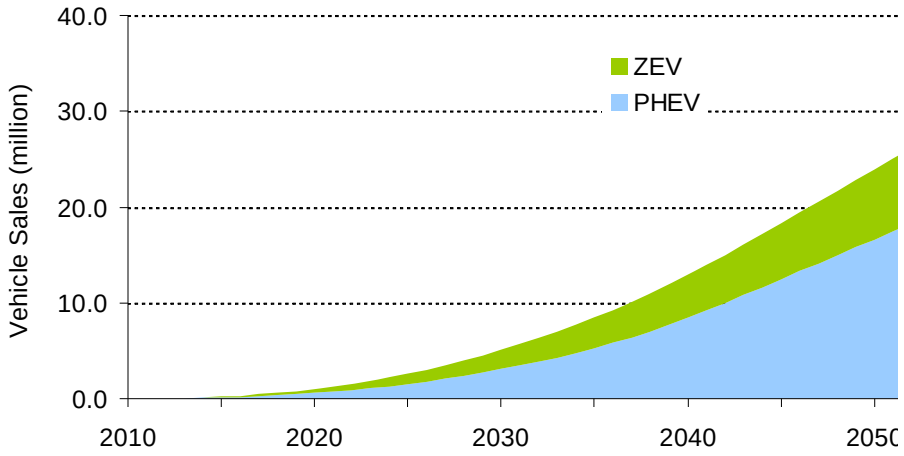


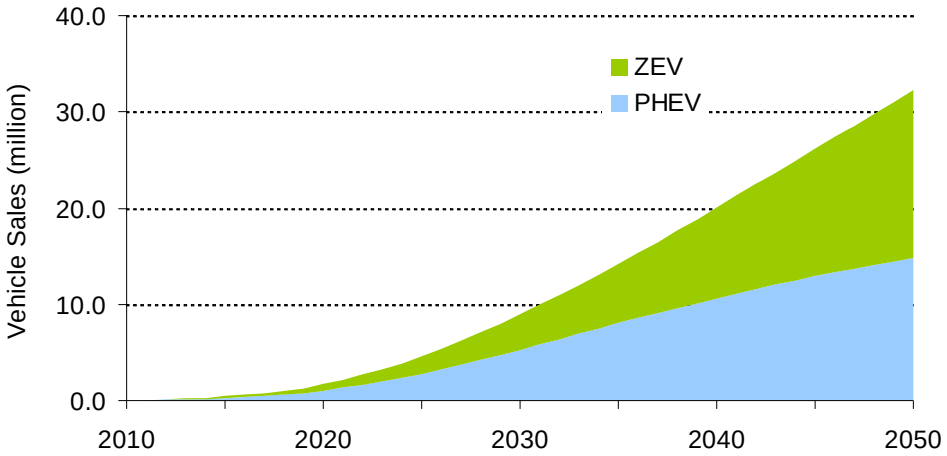
"Achievable Targets" Case



ZEVs on the Road

- By 2050, significant number of ZEVs and Enhanced AT PZEVs will needed on the road (~ 30 million vehicles) out of 42 million forecasted
- Significant amounts of “electrified” miles (50 to 70% of all miles traveled on low carbon electricity)





Conclusions

- ZEV and Enhanced AT PZEV numbers will need to be sold in significant numbers by 2020, with the range established based on the principle of achieving 2020 and 2050 climate goals.
- Range in ZEV vehicle sales will depend on how well other transportation policies achieve their targets
- Rapid electrification (hydrogen or electricity) and hybridization of the fleet will need to occur to achieve climate goals. Moving from tens of thousands (initial market) to large-scale commercialization (hundreds of thousands) by 2020.
- If early sales trajectory is missed, significantly higher sales will be needed shortly thereafter which may be unrealistic.