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Sandia National Laboratories

Parachoice Truck

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U.S. DEPARTMENT OF ENERGY NNSA

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Outline

- Bottom line up front
- Selection of long haul tractor truck
- Key inputs & mapping
- Preliminary analysis results
- Future Work

Bottom Line Up Front

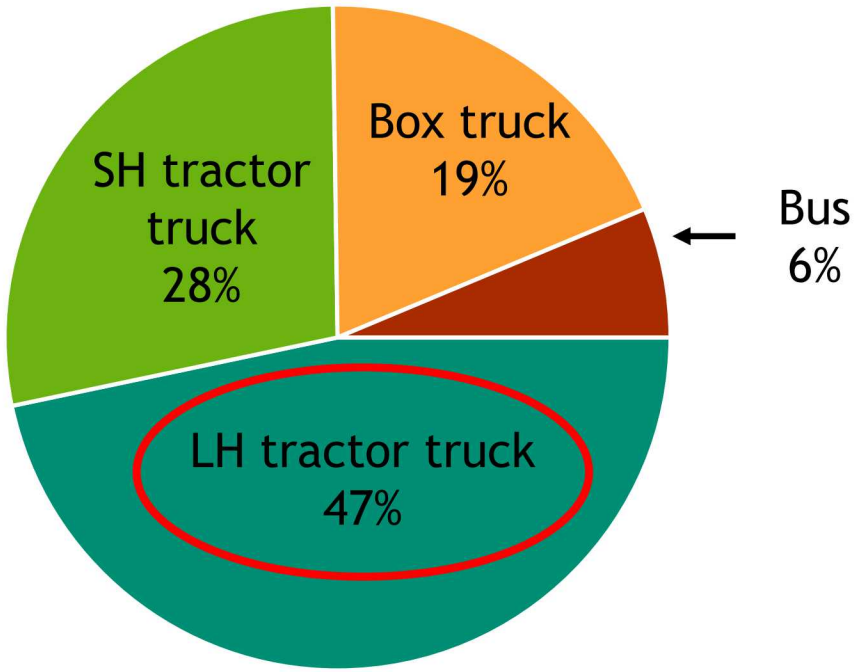
- Parachoice code for heavy duty trucks (Class 7 & 8) has been updated and exercised
  - The model responds as designed, with vehicle adoption and infrastructure growth evolving with (simulation) time based on inputs
- For long haul tractor trucks, results for the baseline case suggest alternative fuel vehicle adoption is unlikely
  - AFVs: Battery electric, plug in hybrid and fuel cell trucks (BE, PHE, FC)
  - Will require significant technology progress and cost reductions, accompanied by incentives in purchasing, infrastructure and carbon credits
- Modeling is only as good as the input data & assumptions
  - Significant gaps remain in obtaining coherent data that is directly mappable to segmentation areas
  - Data gaps include vehicle efficiency, cost, vehicle miles travelled (VMT), vehicle stock, infrastructure cost, etc.
  - Model to be calibrated.

Selection of long haul (LH) tractor truck as exemplar

Selection is driven by:

- Impact of segment (fuel use) based on vehicle stock percentage, VMT and weight of class 7 and 8 HDVs
- Data availability & quality

Share of fuel use

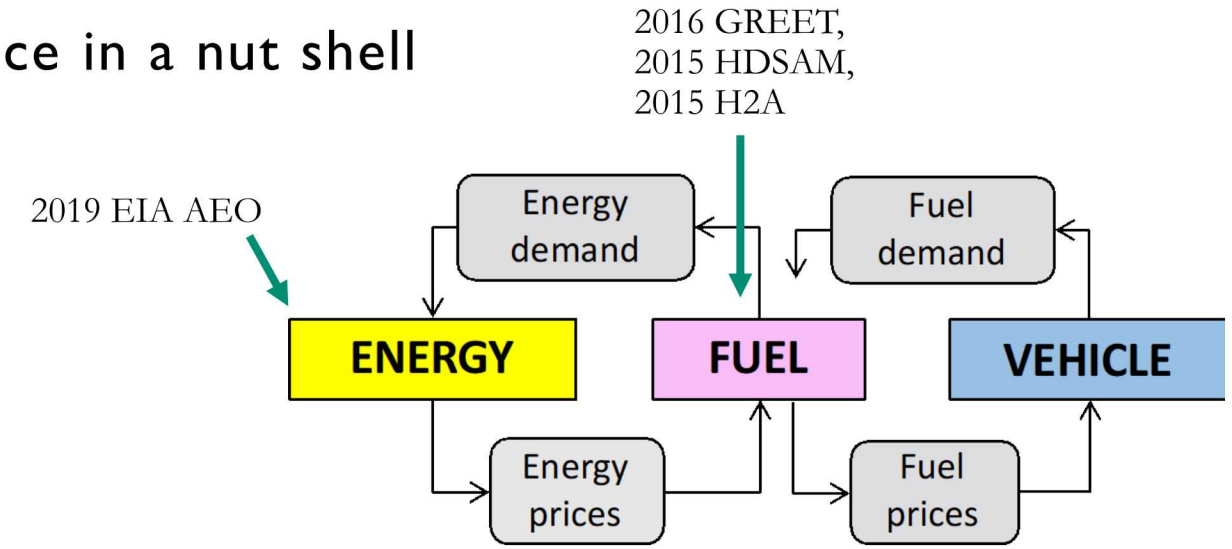


Data assessment summary (aggregation, age, source)

	Tractor truck	Box truck	Bus
Vehicles	Good aggregation Older data Source is raw survey	Good aggregation Older data Source is raw survey	Good aggregation Older data Source is raw survey
VTMT	Good aggregation Recent data Source is raw survey	Good aggregation Older data Source is raw survey	Poor aggregation Recent data Source is processed/condensed data
Efficiency	Good aggregation Recent data Source is model output	Good aggregation Older data Source is model output	Good aggregation Recent data Source is model output
Fuel cost	Good aggregation Recent data Source is model output	Good aggregation Recent data Source is model output	Good aggregation Recent data Source is model output
Purchase cost	Good aggregation Recent data Source is market data	Unclear aggregation TBD data Source is scaled assumptions	Good aggregation Recent data Source is market data

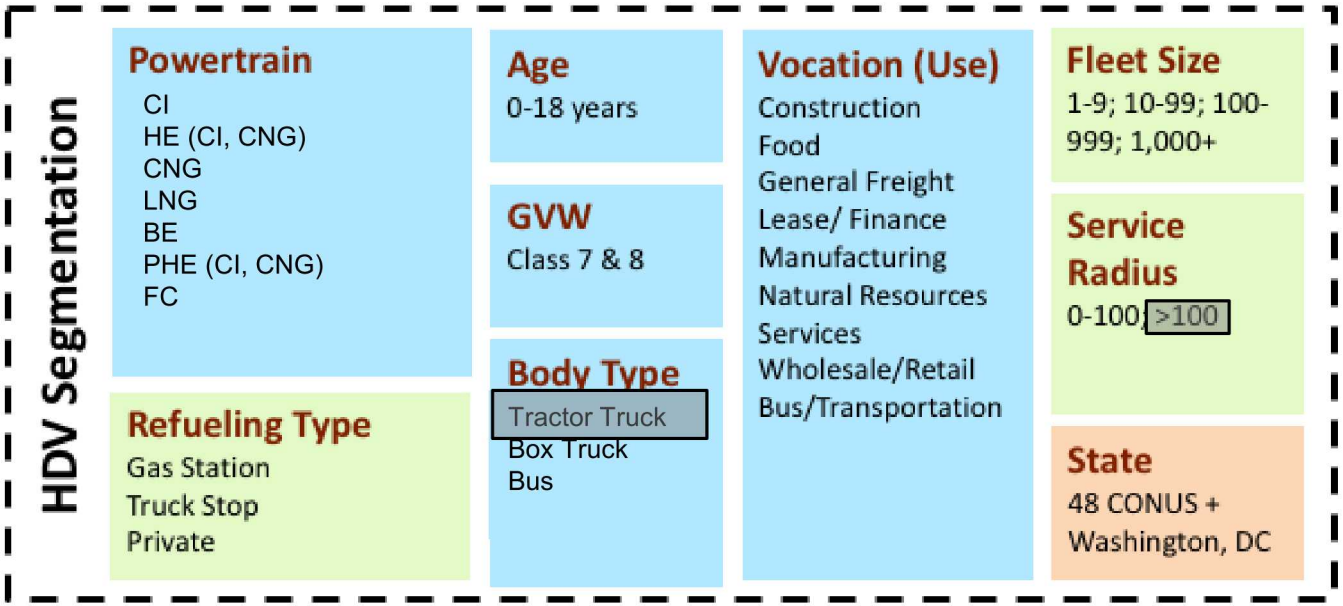
Long haul tractor truck segment has the most impact + available data

Parachoice in a nut shell



- Stock: 2011 & 2013 Polk
- VTMT: 2002 VIUS, 2019 APTA, 2018 FHWA FAF4
- Efficiency:
  - 2018 Autonomie BaSce
  - 2012 NPC ATATP report, 2016 Clean Cities NG Regional Transport Trucks Case Study
  - 2016 EPA-NHTSA efficiency mandates
- Purchase cost
  - 2018 Autonomie BaSce
  - 2018 Foothill Transit Agency publications
  - 2017 ICCT Zero emission freight trucks

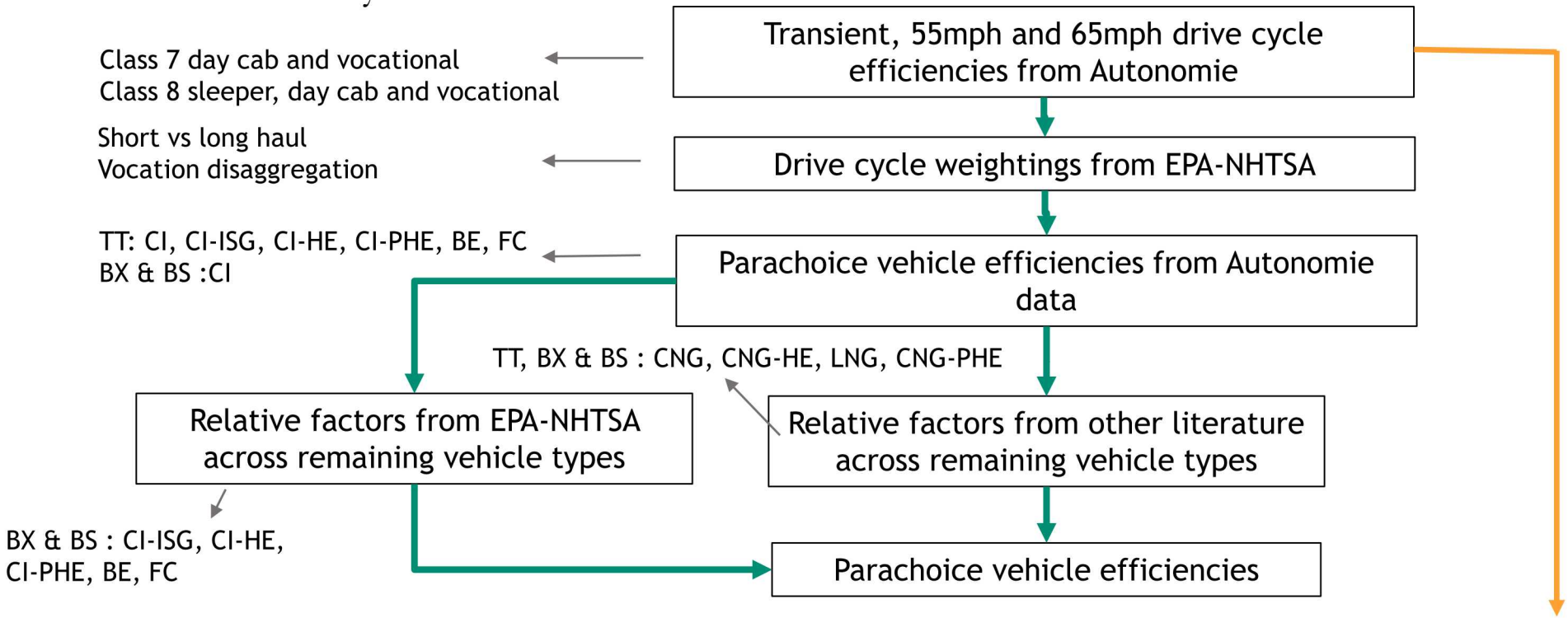
Parachoice Truck incorporates segmentation across multiple factors based on VIUS/Polk categories:



Focus of this presentation → long haul tractor truck across powertrains

Parachoice use of data (efficiency shown)

Parachoice uses an amalgamation of multiple data sources, normalized to Autonomie along the EPA-NHTSA certification cycles



Highlighted cells based on MD-HD BaSce, 09-24-18

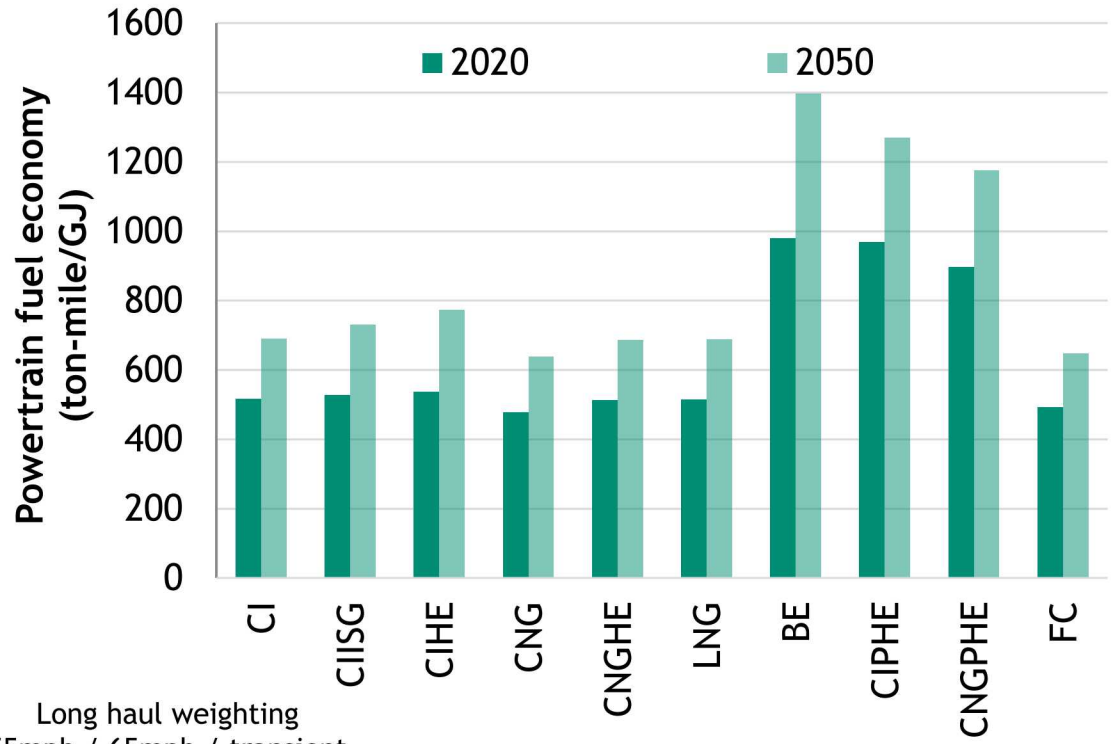
Data received was Class 7 DayCab

		TRUCK Technologies*						
HDStock Class	Autonomie Vehicle	Base	Adv Conv	ISG	HEV	PHEV	BEV	FCV
Class 8 Sleeper	8 Sleeper_HR	x	x	x	x		x	x
Class 7&8 DayCab	8 DayCab_HR	x	x	x		x	x	x
Class 7&8 Voc	8 Vocational	x	x	x	x	x	x	

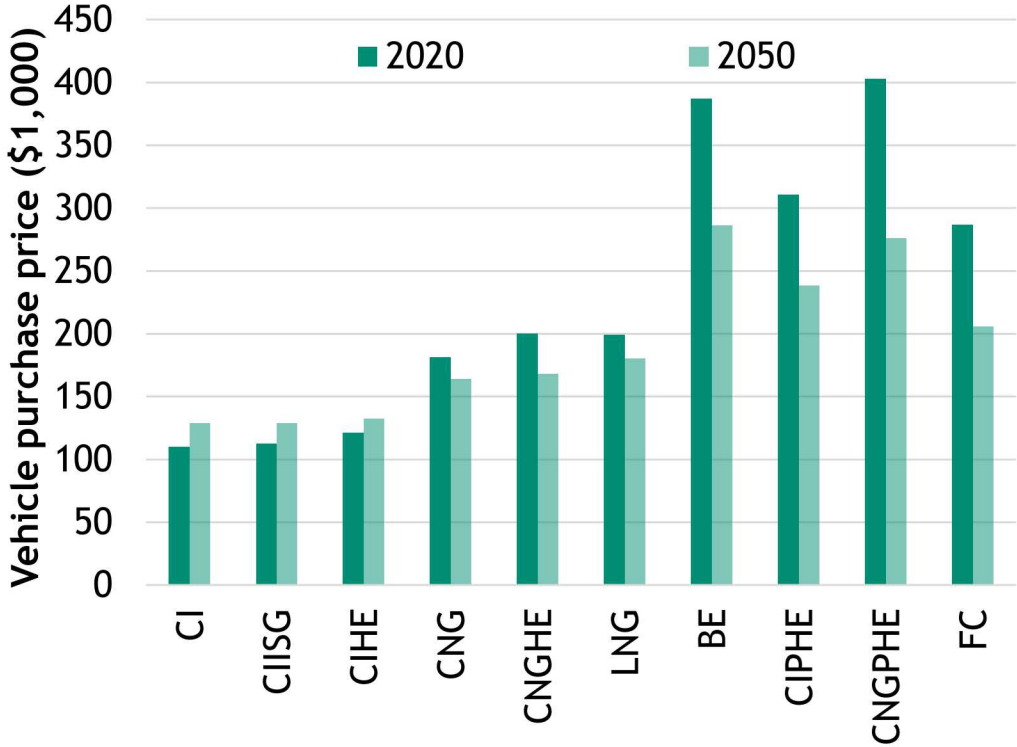
Table extracted from T.Stephens, Program Benefits Analysis Status Update, 10-16-19

Efficiency and Cost inputs

Baseline inputs for class 8 long haul tractor trailer, "Low" tech case

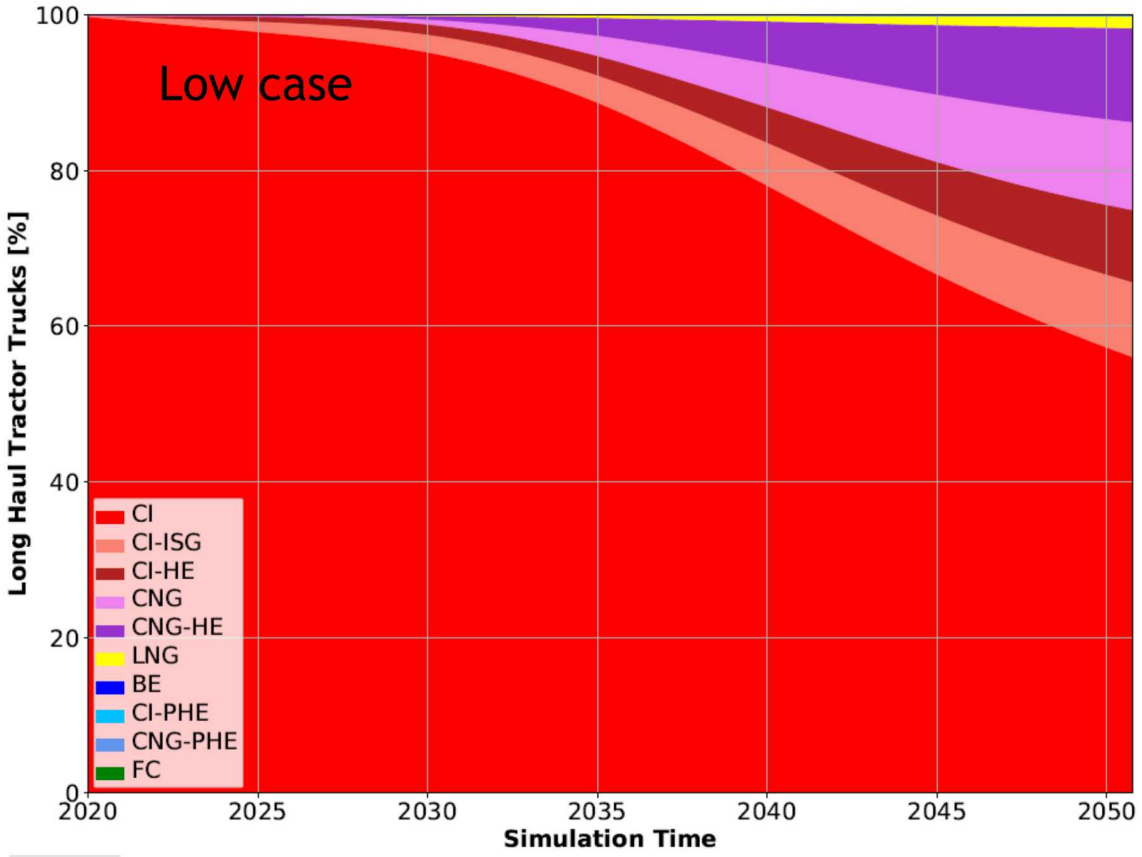


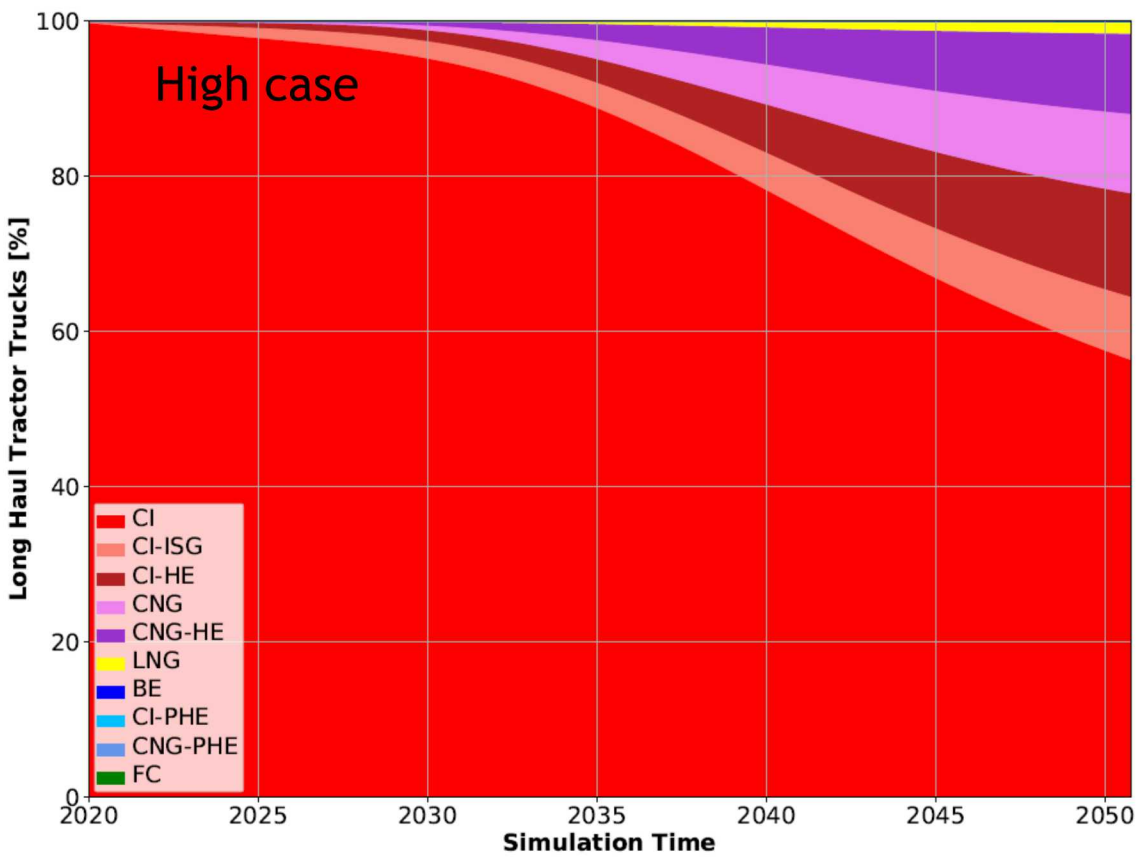
Long haul weighting
55mph / 65mph / transient
9/ 86/ 5



Baseline stock share – "Low" vs "High" tech case

Larger penetration of diesel hybrid (CI -HE) in the High case



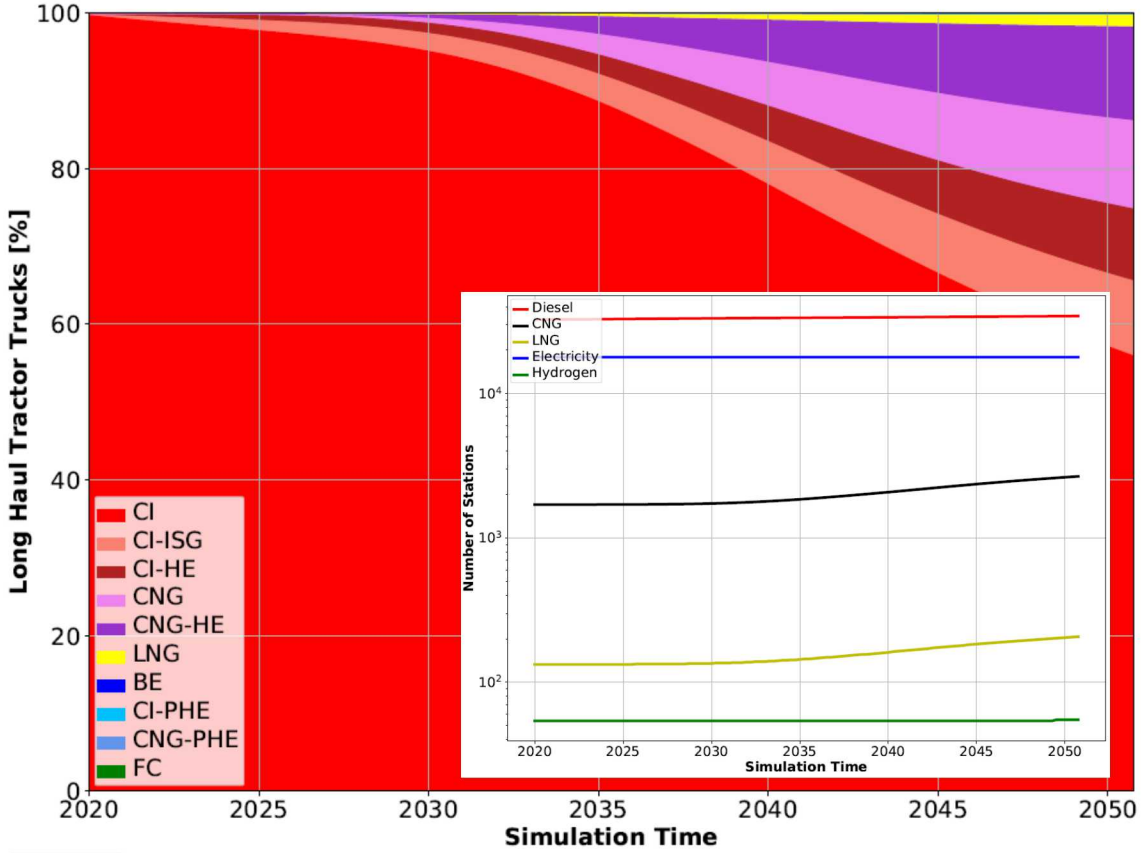


Conventional powertrain continue to dominate segment through 2050

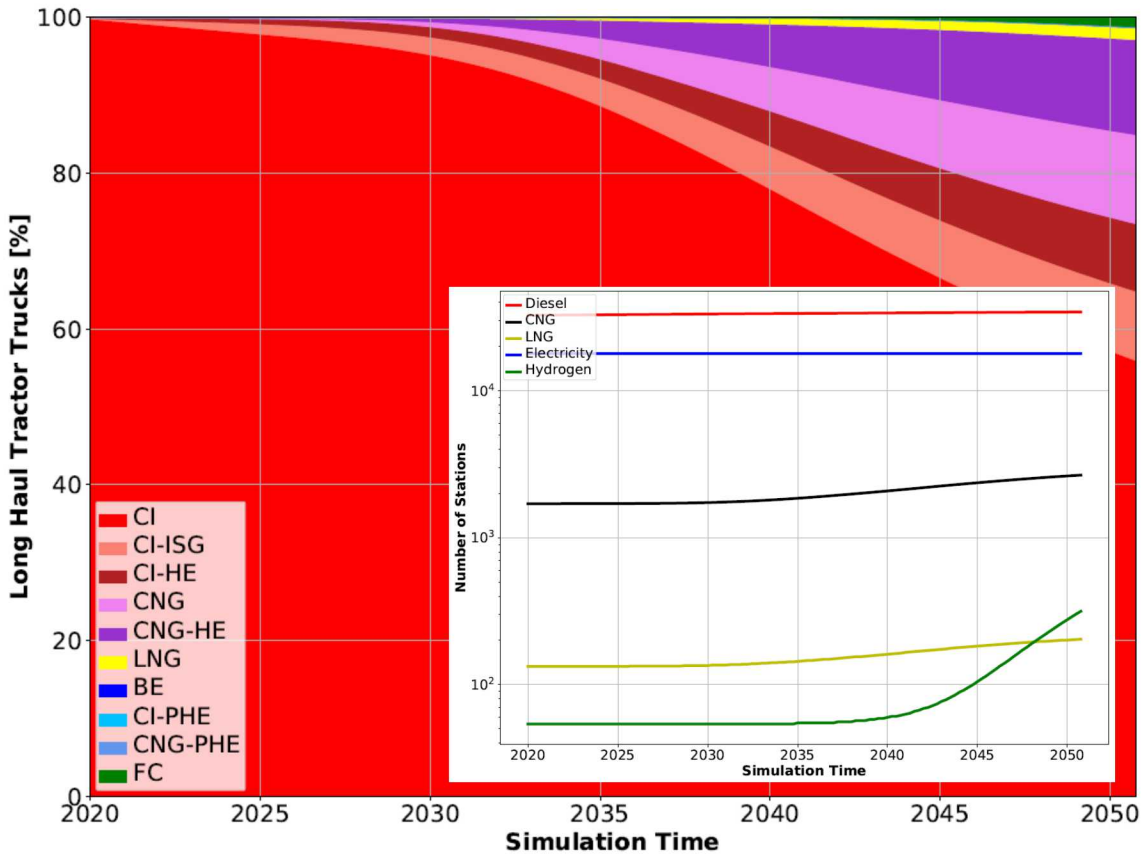
Test case for FCEV response

FC cost: Baseline → 0.5x

Base "low" case



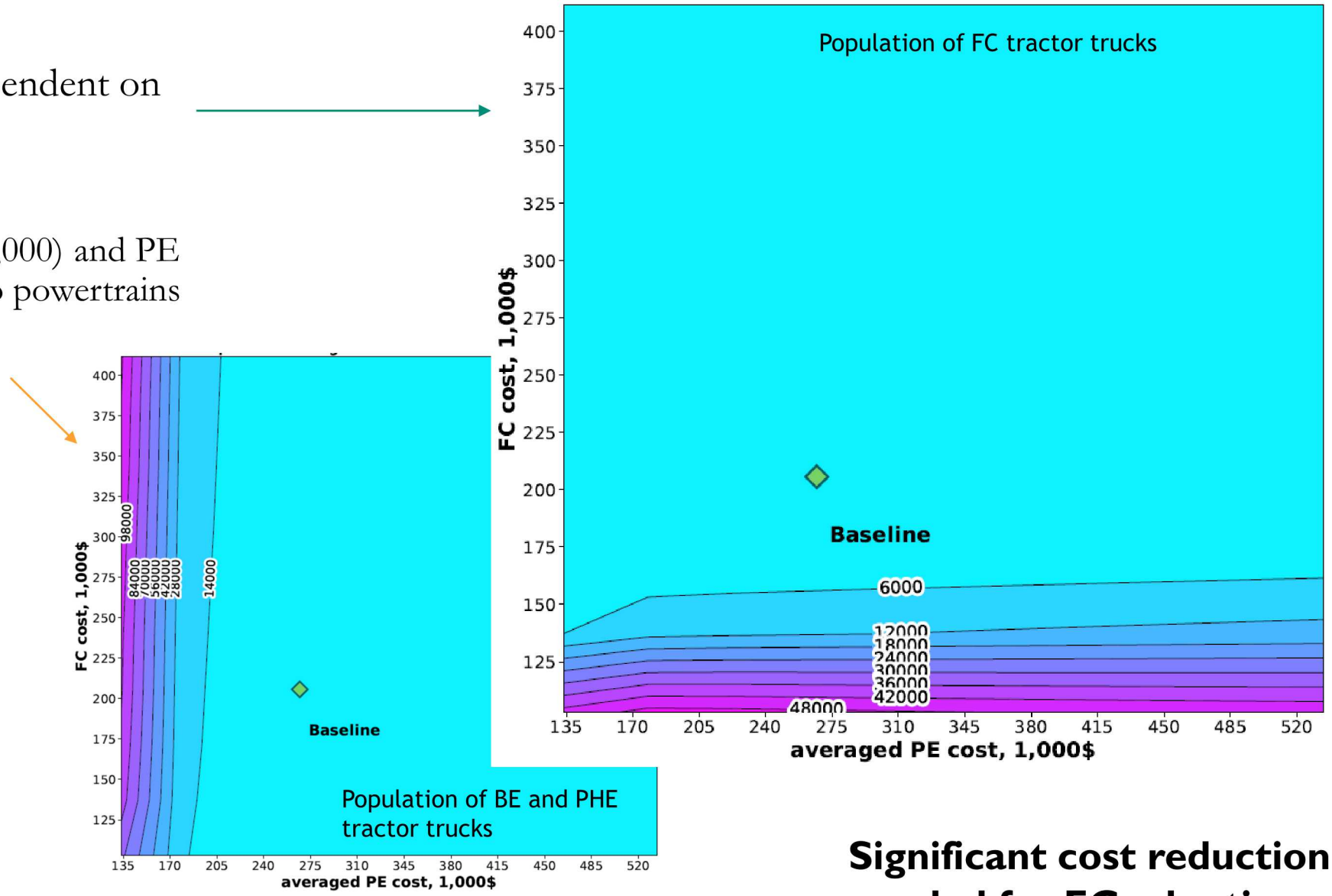
Test case



FC vehicles at 2050 as functions of FC purchase cost and PE (BE & PHE) purchase cost

- FC adoption is largely dependent on reduction in FCV cost.

- Comparing FC and PE:
  - At lower FC cost (e.g. $125,000) and PE cost (e.g. $170,000), the two powertrains begin to compete.



Significant cost reduction needed for FC adoption

Near term future work

Priority

- Calibrate model to AEO 2019 Reference case
- Solidify the data inputs for long haul tractor truck analysis
  - Obtain powertrain data outside of class 8 sleeper cab
- Investigate treatment of infrastructure growth rate (currently based on ratio to the number of vehicles)

Questions?