Truck Decision Choice Modeling

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Motivation for Model

• Climate change goals
  – Climate science has suggested a goal of reducing greenhouse gas emissions (GHGs) 80% below 1990 levels by 2050 to limit negative effects of climate change
  – CA Governor’s goals: Reduce petroleum usage 50% by 2030

• Two major paths
  – Increased fuel economy
  – Low carbon fuels (electricity, hydrogen, biofuels)
Truck Decision Choice Model Description

• Use model to understand the reduction of greenhouse gas emissions using new technologies and fuels
• Model includes truck stock turnover, fuel economy, vehicle costs, operating costs. Model extrapolates out to 2050.
• For most models, researchers put market penetration in by hand – doesn’t capture real world issues
• Decision choice model
  – Understand which factors influence purchase decisions
  – Use these factors to determine how real world fleets will make purchase decisions under various conditions
  – Investigate effects of various public policies
Truck Types, Technologies, Fuels

- Truck Types
  - Long-haul, Short-haul, MD urban (delivery), Buses, Vocational, HD pickups and vans
- Truck Technologies
  - Diesel, Gasoline, LNG, CNG, Hybrid, Battery electric, Fuel cell
- Fuels
  - Diesel, gasoline, natural gas, electricity, hydrogen
- Other Technologies/fuels
  - Later model versions
**Decision Choice Factors**

- Capital Cost
- Operating costs (fuel use, maintenance)
- Green PR (Environmental perception)
- Risk (maintenance issues, downtime, secondary market sales, etc.)
- Incentives / Subsidies / Carbon Tax
- Model availability (# models, # OEMs in market)
- Vehicle Range
- Refueling Time
- Station Availability
Model Operation

• Determine factor importance by assigning a cost to each factor (Cost will in general vary with time)
  – Capital, operating, incentive costs are straightforward
  – Risk, model availability, Green PR are not

• Develop formulas to transform knowledge about factor into cost (How?)

• Sum all factor costs to create a generalized cost

• Use generalized costs for each vehicle/technology type to determine the market shares year by year
Generalized Cost Example: Model Availability

• Are any models available?
  – What year will first model be available?
• How many OEMs have commercial model?
  – How long after demonstration vehicles to first OEM commercialization (and second OEM...)
• How does model availability depend on total vehicle sales?
• How important is each question to fleet managers’ decisions?
Generalized Cost Example: Model Availability

More vehicles/models sold

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Fleet Purchase Categories

• For each truck type sub-divide into fleet purchase categories
  – Early Adopter
    • Large fleets?
    • Niche markets?
  – Late Adopter
    • Owner operators, small fleets
  – In Between
• What percentage of fleets assign to each category?
• How do factors vary by category? (e.g. payback period, risk)
Sales Shares (fraction) of HD Pickups (Example)
Specific Questions

- How does risk change (maintenance issues, downtime, sales into secondary market, etc.) as total sales increase?

- Can Green PR be an important factor for some fleets? How important?

- What are timelines for introduction of commercial technologies (battery electric, fuel cell) for various vehicle types (heavy-duty, medium duty delivery trucks, etc.)?

- What are ramp-up times between demonstration vehicles, first commercial models, and 5% or 10% market share of sales?
Thank You