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)

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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

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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)

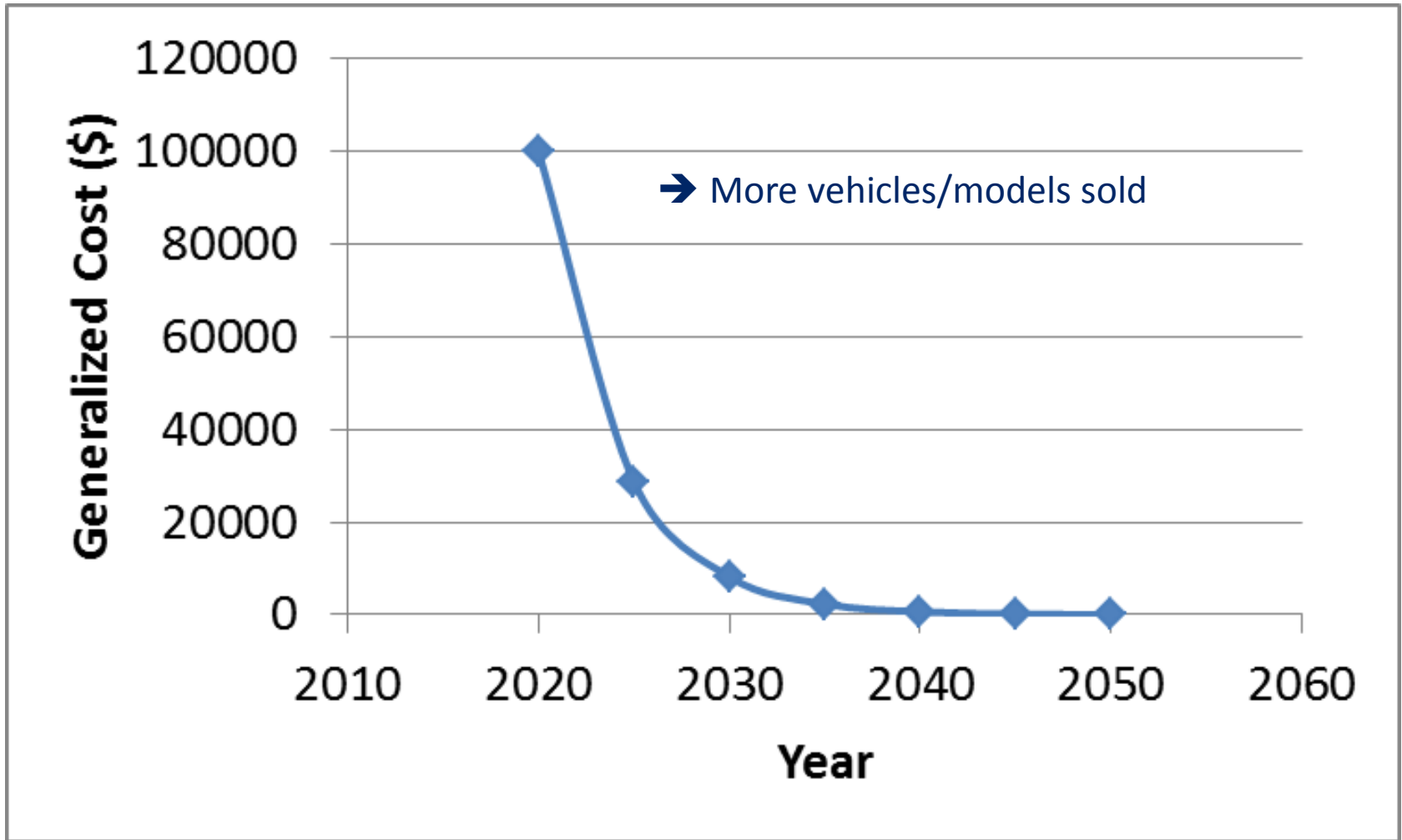- Vehicle Range

- 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

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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?
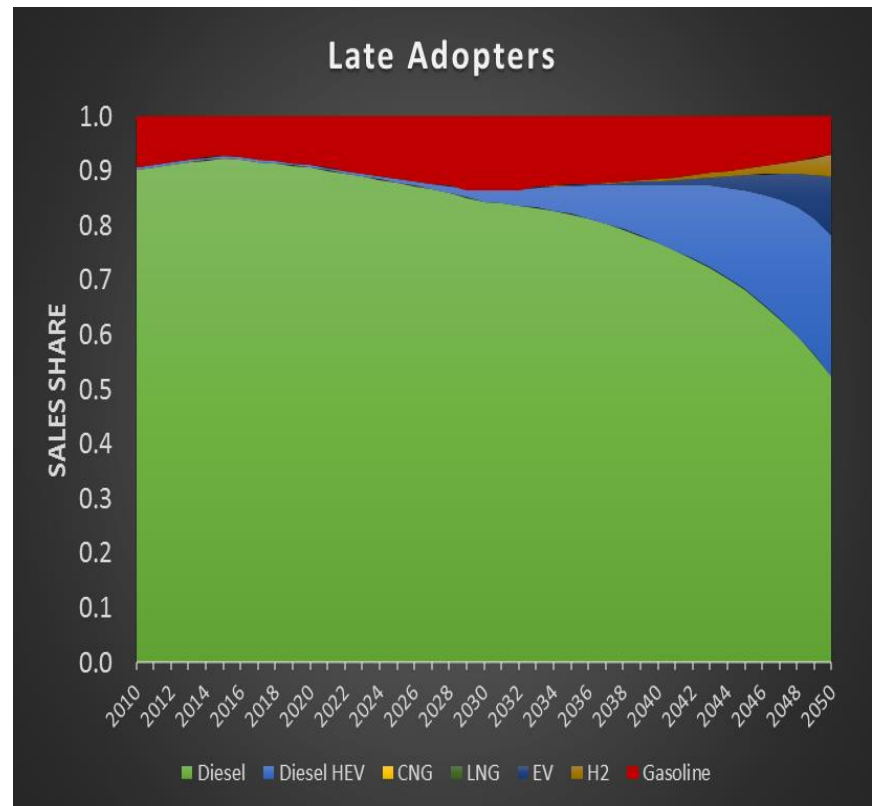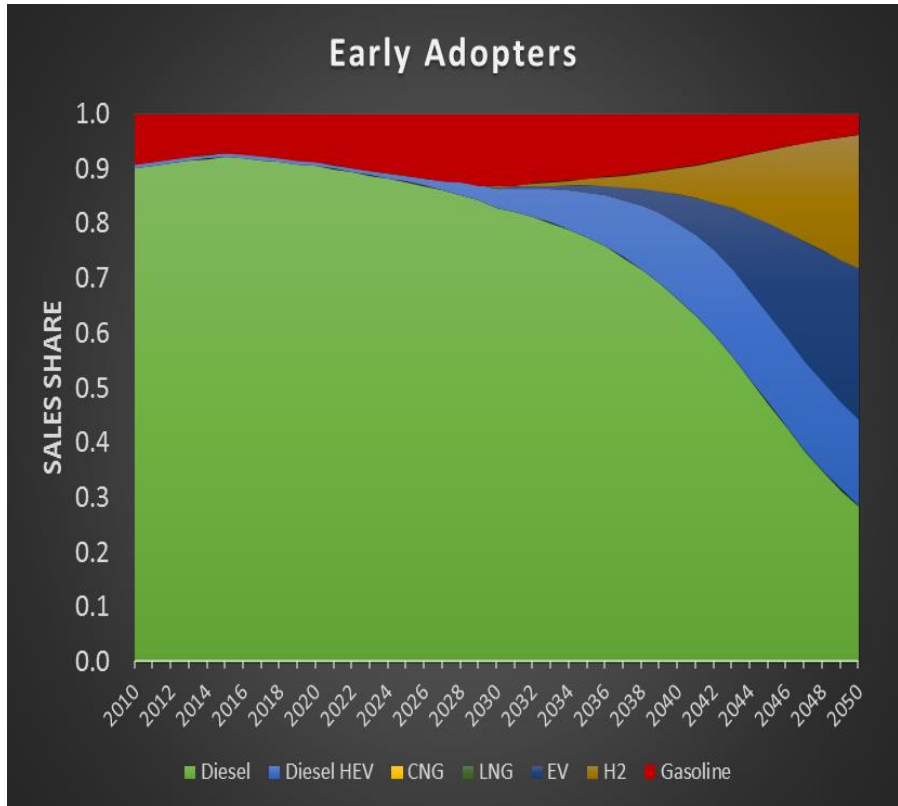
Generalized Cost Example: Model Availability

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)

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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?

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Thank You