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Analysis of an Electric Vehicle Subscription Service Business Model that Includes Battery Swapping for the San Francisco Bay Area Market

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EV Battery Swap Model Attributes

- Third party owns battery
  - Takes on cost
  - Takes on risk (premature failure and theft?)
  - Updates battery technology
  - Streamline battery replace, reuse, recycle
- Subscriber buys only EV (without battery)!
- Extended vehicle range (100 mi/charge + swap)
- Subscription based fee system (cell phone)
- Subscription includes home and public charge stations

Does Battery Swap Technology Work?

- Example: Better Place in Palo Alto, CA
  - http://www.betterplace.com/the-solution-switch-stations
- Renault-Nissan Alliance
- But, is it profitable? If so, how?

Economic Model Assumptions

- Estimated capital costs from literature
- Subscription rates based on gasoline prices
- Capital expenditures are financed by loan
- Base: $3 per gal gas, 3% annual increase
- 20,000 initial subscribers to 70,000 in 15yrs
- Sensitivity analysis done for all inputs

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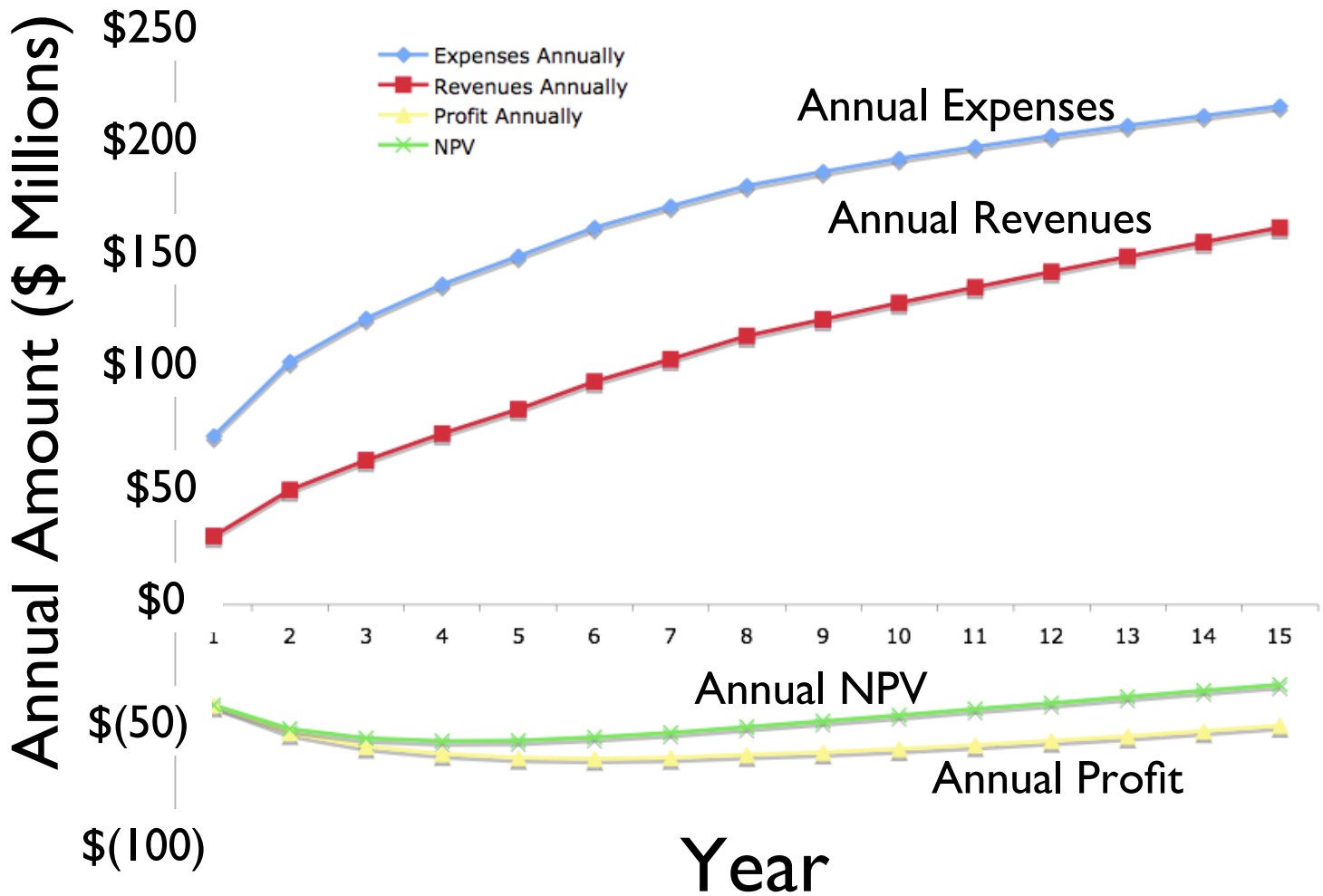
Results - Base case



- Total Net Present Value (NPV) of -$718 million

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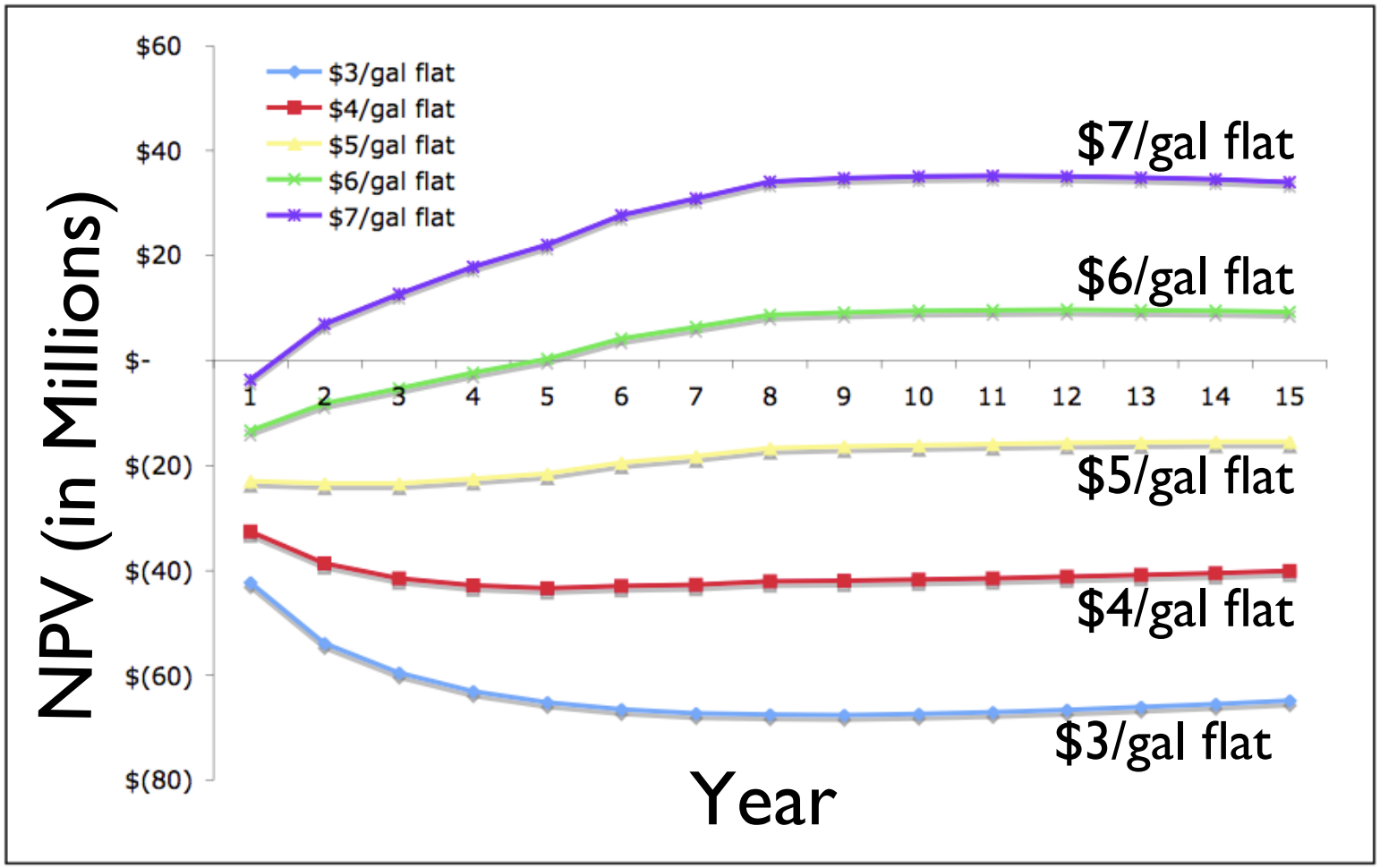
Sensitivity Analysis - Gas Prices



- Flat rate gasoline prices compared

Econ. Sensitivity Analysis Summary

- **High** influence
  - # of subscribers, gas price, battery cost, # corp. and attendant employees, distribution of annual miles driven, ratio municipal capital matching, loan years, interest rate
- **Medium** influence
  - Cost/rent charge spots, electricity rate, discount rate, expected battery life
- **Low** influence
  - Cost/rent swap stations, # charge spots, # swap stations, maint. costs, # reserve batteries
- **Negligible** influence
  - Liability insurance rate, corporate overhead

Scenario Analysis

- Scenario 1(Energy Real Cost Increases)
  - Fuel: US$3/gal to $6.50/gal
  - Electricity: US$0.12/kwh to $0.16/kwh
  - Reduce Municipal Matching for Infra from 50% to 25%
  - Profitable in 13th year
  - NPV -US$385 million (46% less loss)

More Scenarios

- Scenario 2 (Scenario 1 + $1.00/gal)
  - Profitable by 9th year
  - NPV -US$50 million (93% less loss)
- Scenario 3 (Scenario 2 no Muni. Matching)
  - Profitable by 10th year
  - NPV -US$110 million (85% less loss)
- Scenario 4 (Scenario 3 + Labor Cuts)
  - Swap station does not neet attendant
  - NPV US$38 million (105% less loss)

Discussion

- Implementing in Israel, Denmark, Australia, and Japan
- Compatible cars to be manufactured in China?
- United States: Wait and watch?
- Could facilitate significant EV market share
    - Most consumer risks negated
    - Reduce price of vehicle up to 40%
    - Eliminates range issue
    - Zero tailpipe emissions
- Would you "subscribe"?

Conclusions

- SF Bay Area needs (to be economical):
  - $50 million/yr subsidy
    - Equal to $2,500 per subscriber in first year, less for each subsequent year
  - Gasoline at $5.75/gal (increase gas tax $2.50?!)
  - Practical scenarios exist for profitability
- Most influential inputs:
  - # subscribers, gas prices, battery cost, # emply., dist. of annual miles driven, grants and loan terms
- Next step: What is $/ton CO_2 reduced?

Thank You

- Questions?
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