

Greenhouse Gas Implications of Fleet Electrification based on Big Data-Informed Individual Travel Patterns

Supporting Information

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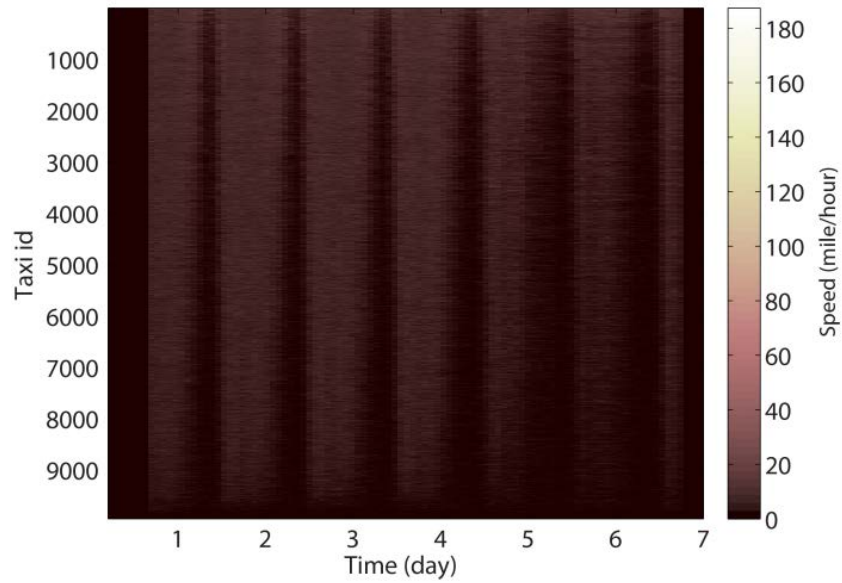


Figure S1. Average speed of each taxi based on the filtered dataset.

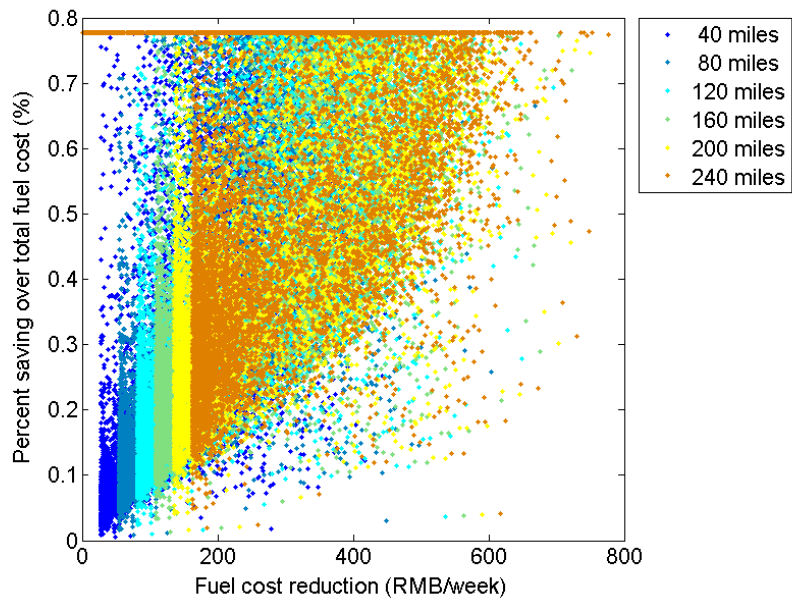


Figure S2. The relationship between percent saving and absolute fuel cost reduction.

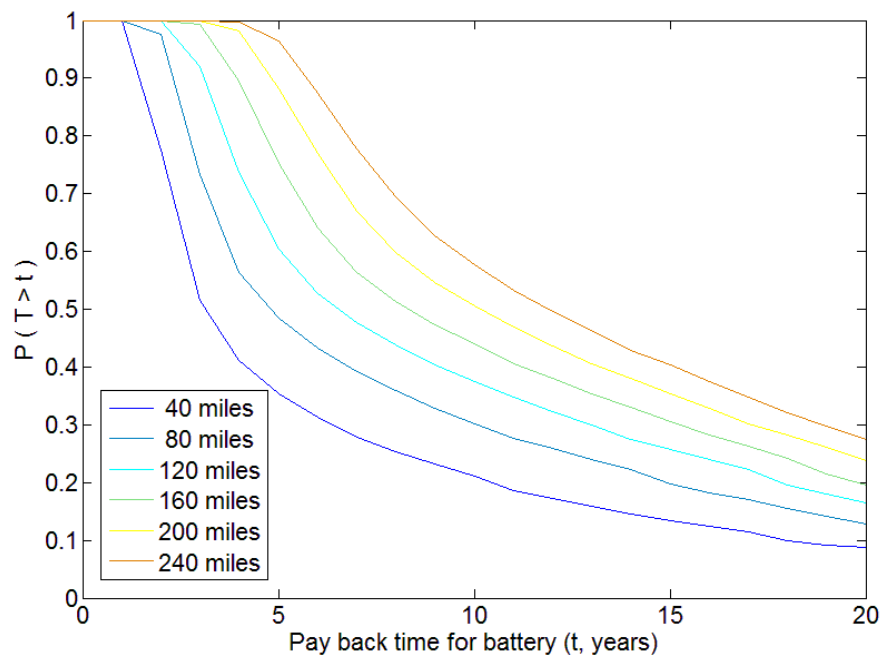


Figure S3. The complementary cumulative probability distribution of payback time with PHEVs regarding different battery sizes (modeled with 30-min segments and battery cost at \$250/kwh).

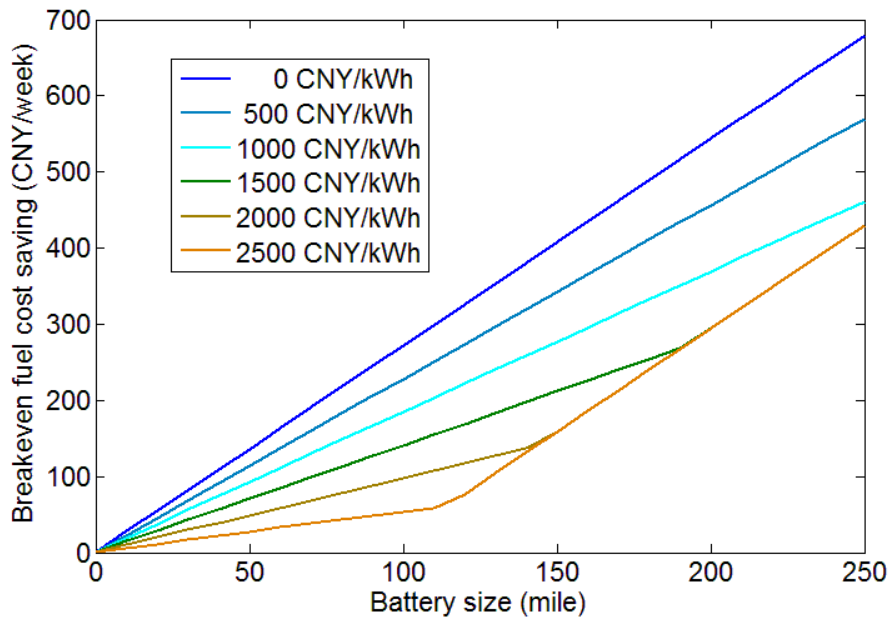


Figure S4. Minimum fuel cost saving required to payback battery cost under different purchasing subsidy scenarios (modeled with battery cost at \$500/kwh and payback time is ten years).

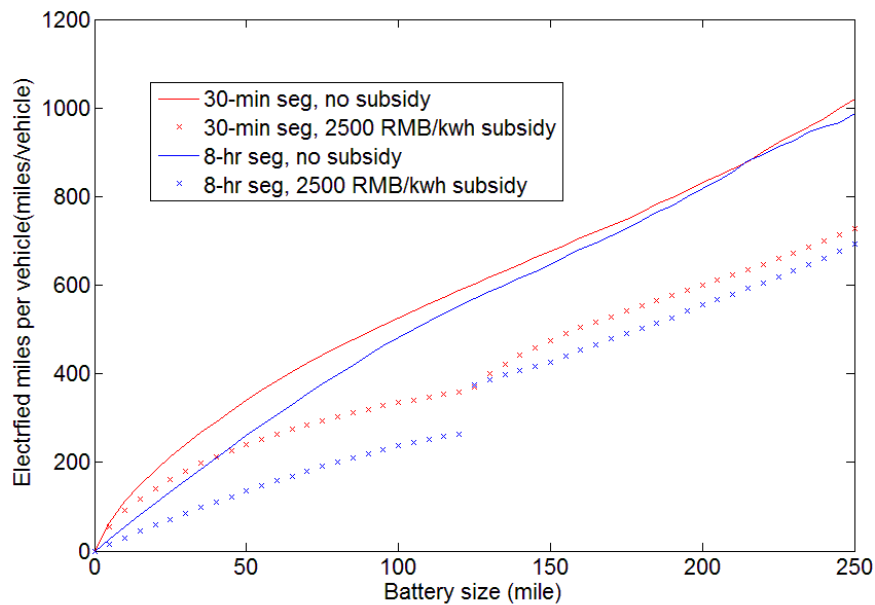


Figure S5. Electrified miles per vehicle regarding to battery sizes.

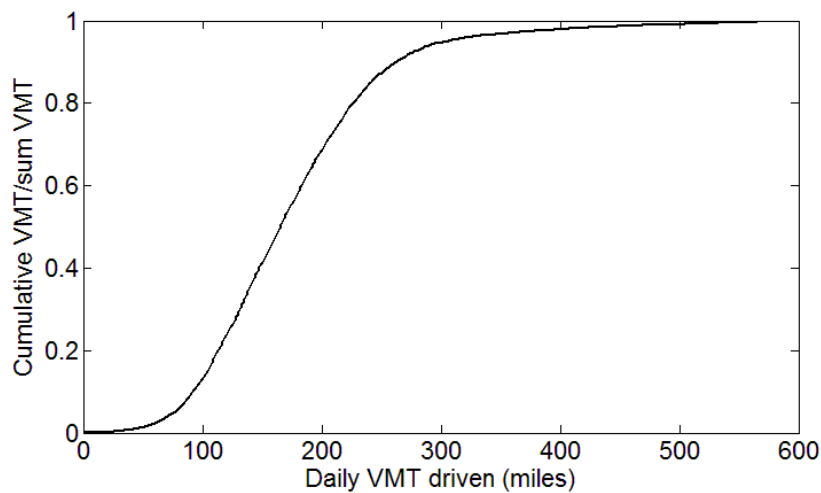


Figure S6. Aggregated daily VMT data of February 4, 2008. Estimate electrification rate based on aggregated daily VMT could lead to statement such as that “Taxis with daily VMT less than 150 miles drive 40% of total VMT. Therefore, 150-mile batteries could electrify 40% of total taxi VMT.”

Key Parameters

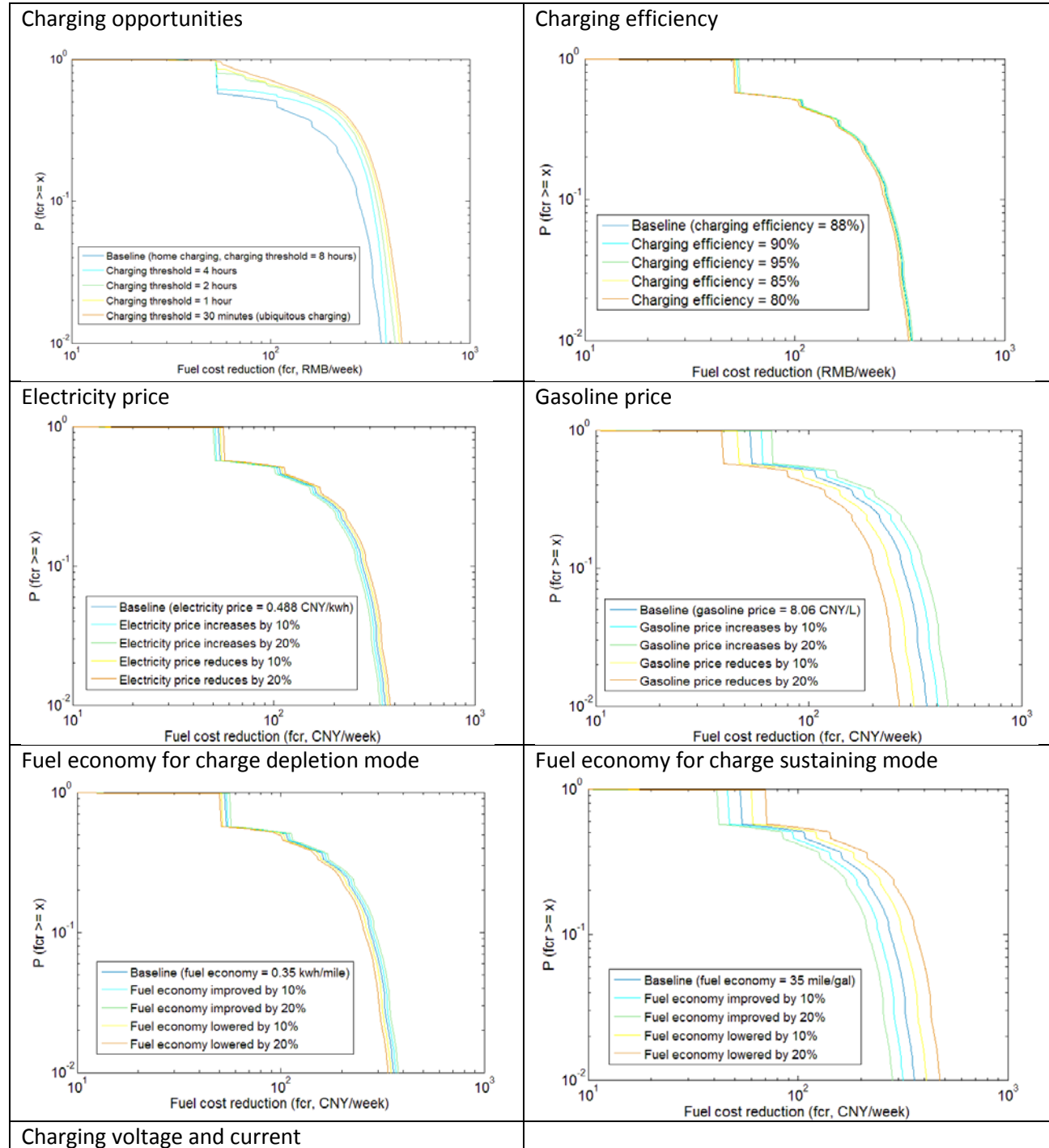
Table S1. Summary of Key Parameters Used in this study.

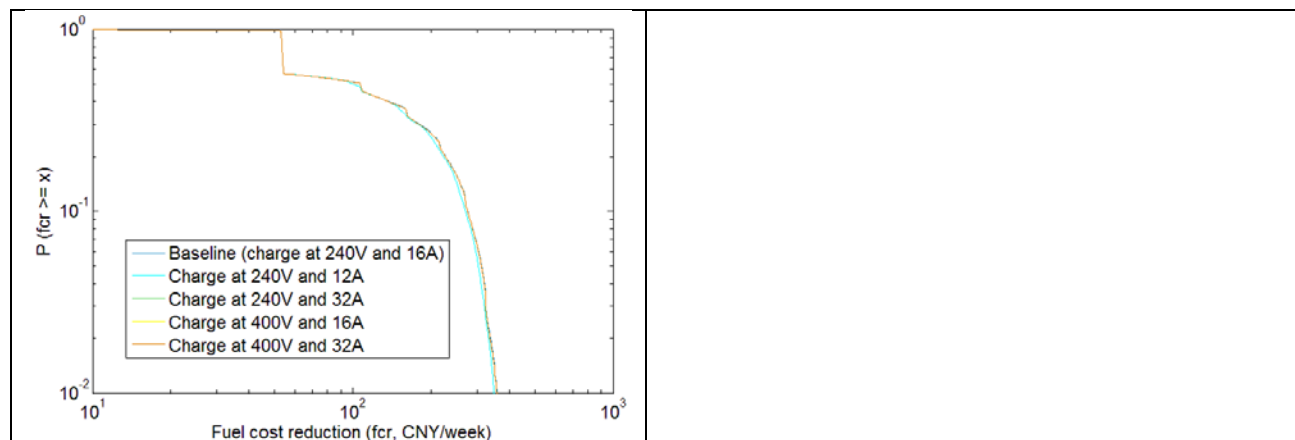
| Parameters | Value | Rationale |
|---|--|--|
| Electricity price | 0.488 CNY/kWh | Current electricity price in Beijing |
| Gasoline price | 8.06 CNY/L | Current gasoline price in Beijing |
| Fuel economy of PHEV (CD mode) | 0.35 kWh/mile ¹ | Based on 2013 Volt |
| Fuel economy of PHEV (CS mode) | 35 mile/gal ¹ | City travel of on 2013 Volt |
| Fuel economy of ICE vehicles | 35 mile/gal ¹ | Assumed to be the same as PHEV in CS mode |
| Charging voltage, current, and efficiency | 240V, 16A, 88% ² | Moderate charging speed and efficiency |
| Baseline battery price | \$500/kWh ³ | Current battery price |
| Government subsidy | 2,500 CNY/kWh with cap of 100,000 CNY/vehicle ⁴ | Current level subsidy for PHEV in China |
| Greenhouse gas emission factor (battery) | 120 kg CO ₂ -eq/kWh ⁵ | Emission factor for Li-ion battery |
| Greenhouse gas emission factors (fuel cycle) | 224.4 g CO ₂ -eq/km (gasoline vehicle); 236.7 g CO ₂ -eq/km (electric vehicle North grid); ⁶ | Best available vehicle fuel cycle emission factors for China |
| Average CO ₂ intensity for natural gas generated electricity | 0.47 kg CO ₂ /kWh ⁷ | China electricity sector data |

Sensitivity Analysis

Fuel cost reduction

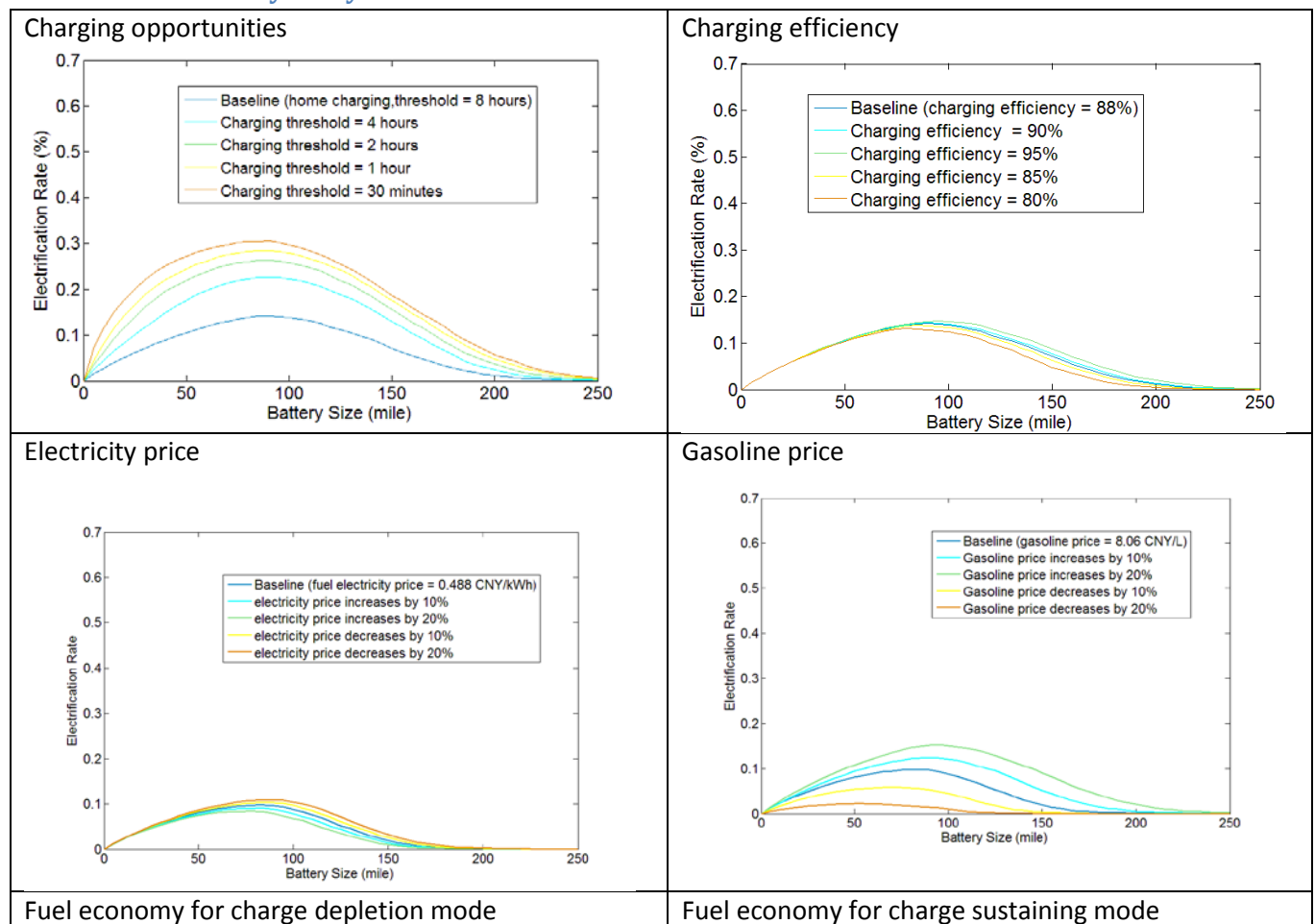
Table S2. Sensitivity analysis results for fuel cost reduction.

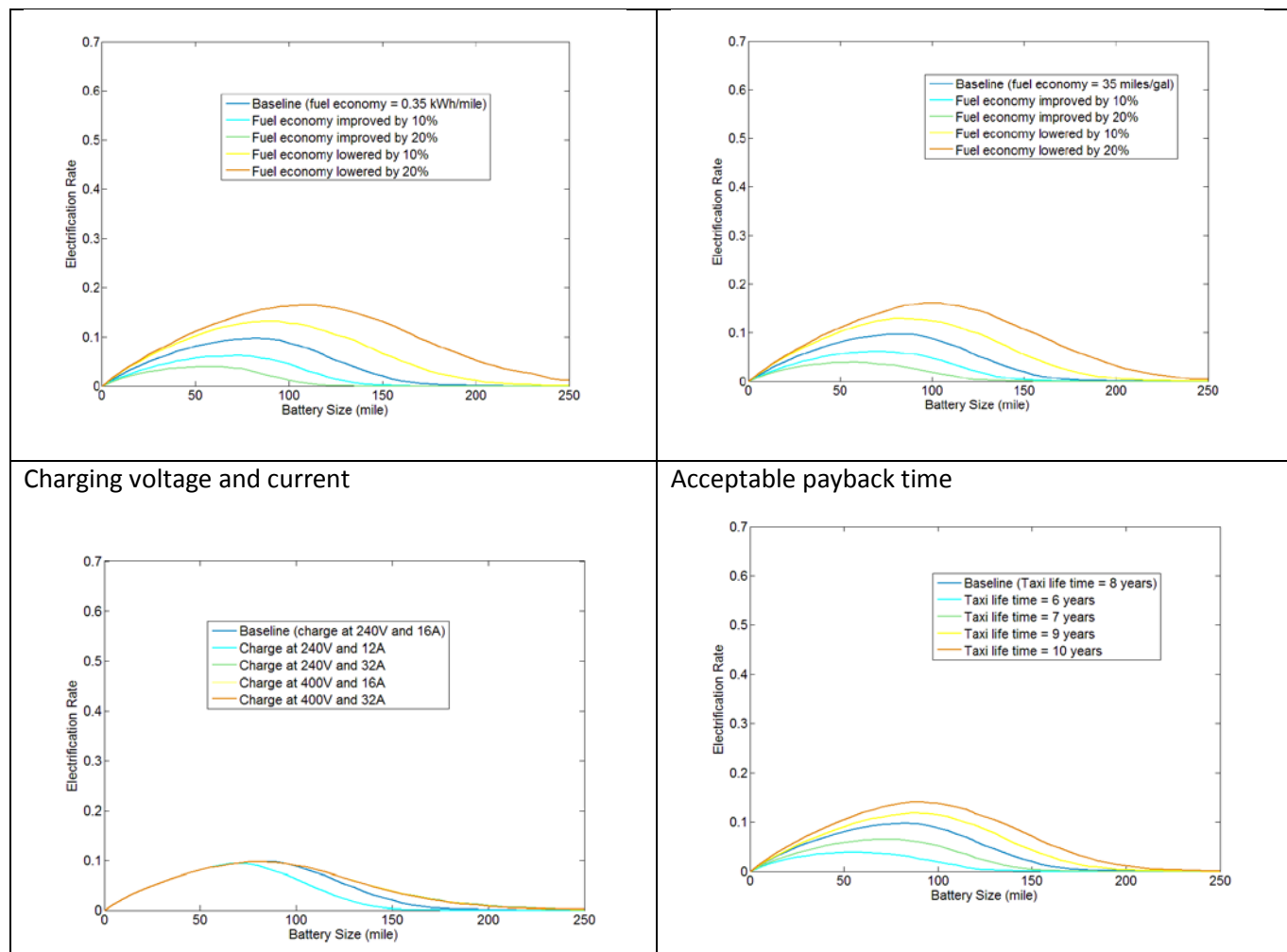




Electrification rate

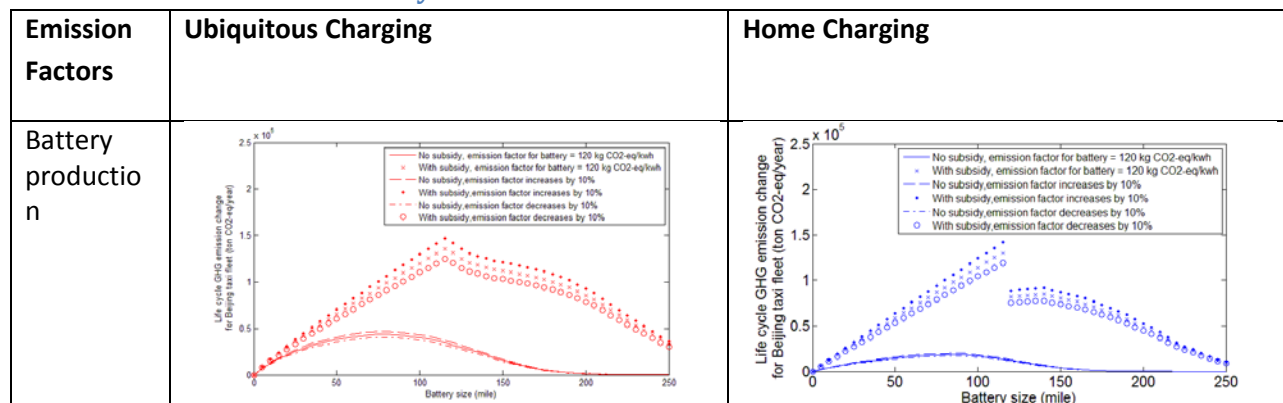
Table S3. Sensitivity analysis results for electrification rate.

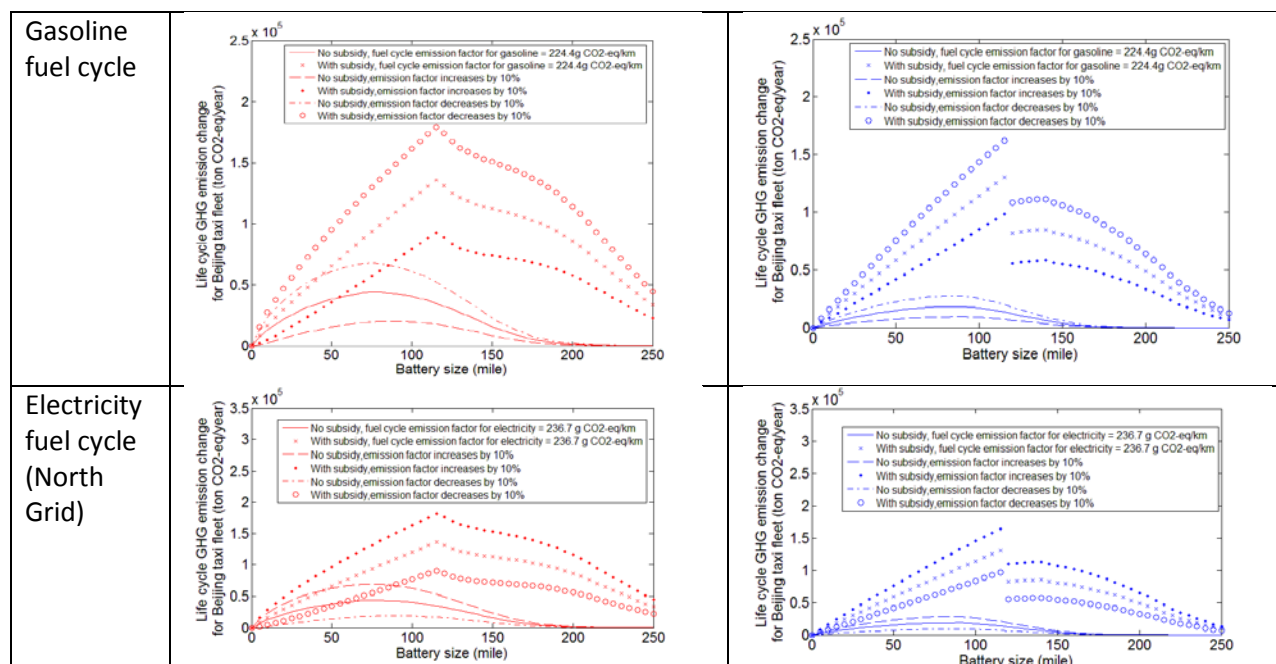




Sensitivity analysis for greenhouse emission

Table S4. Results of sensitivity test for emission factors.

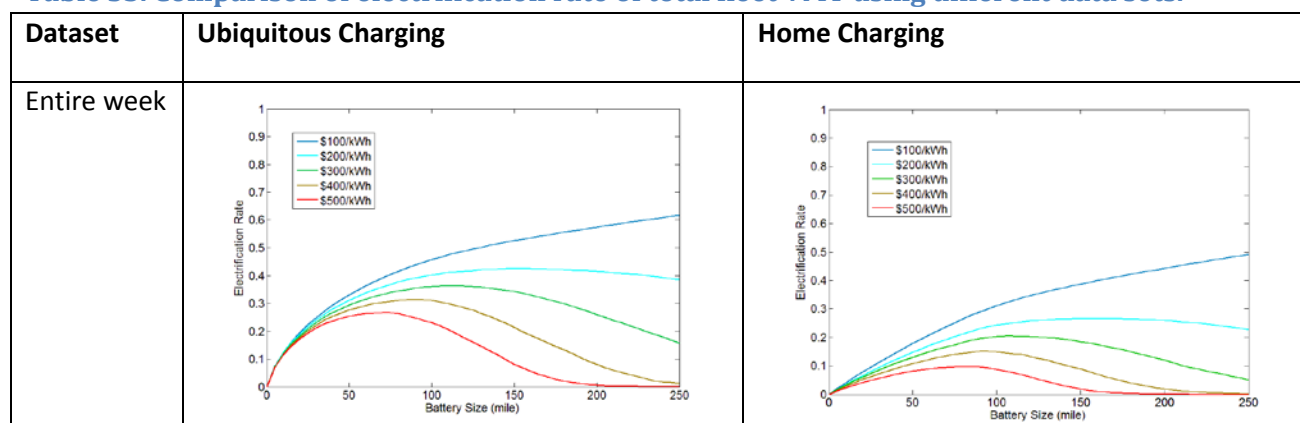


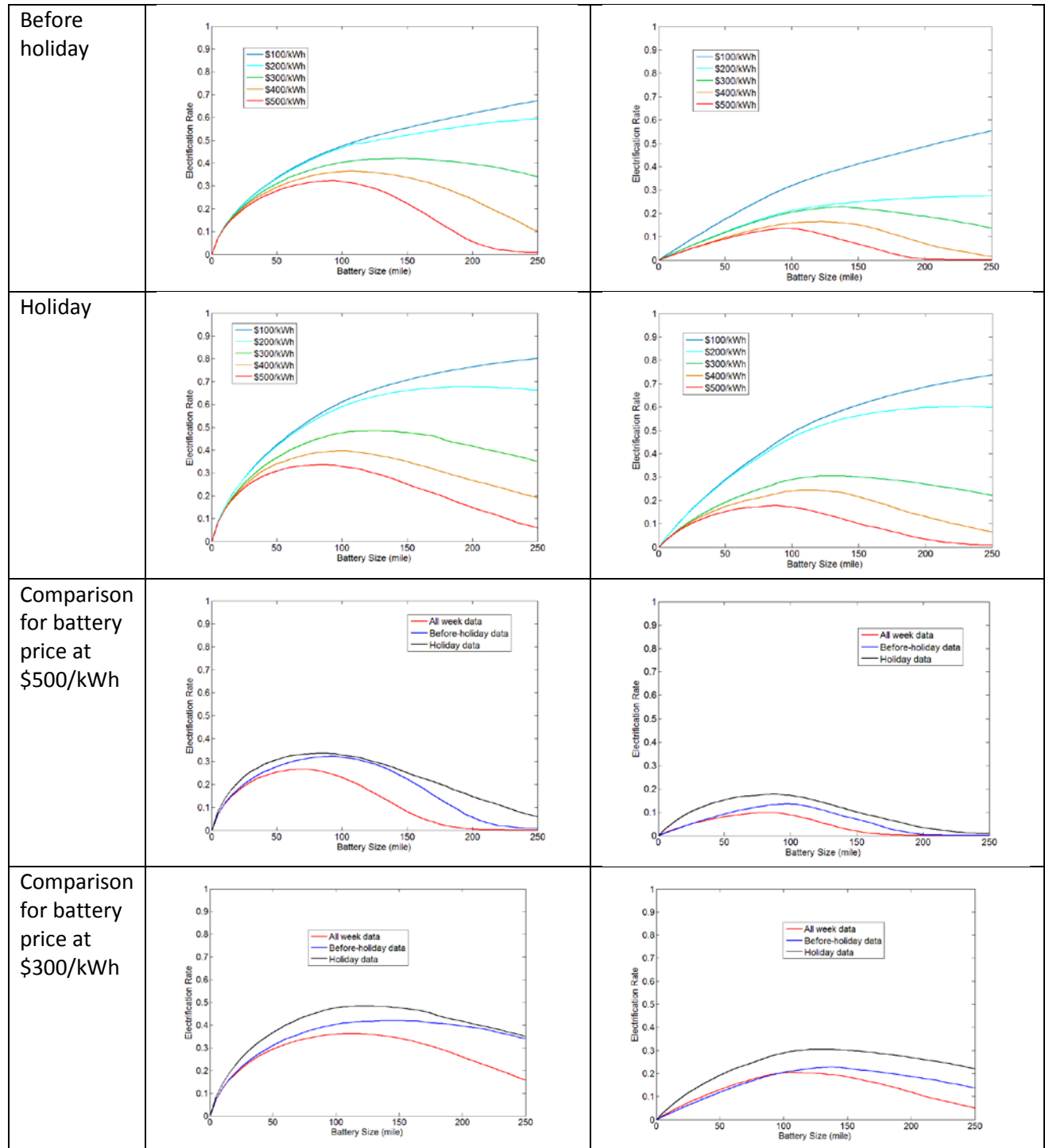


Impacts of the holiday on electrification rate

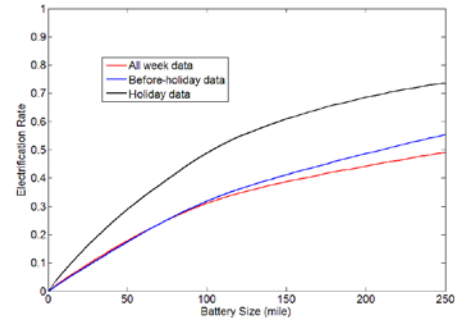
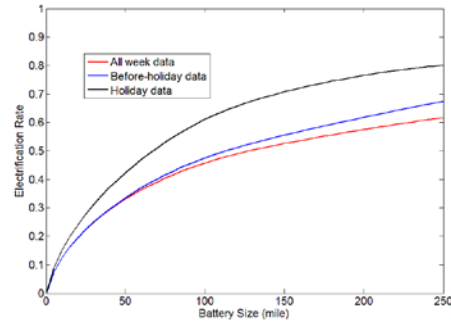
Because February 7th, 2008 was the New Year's Day based on lunar's calendar, a major Chinese holiday, we separate the data sets into two subsets to analyze the impacts of the holiday on the results. The "before holiday" dataset contains data from February 2nd to 5th, and the "holiday" dataset contains data from February 6th (Chinese New Year's Eve) to February 8th. Because the relationship of electrification rate and battery size is the basis for subsequent subsidy and emission analysis, only electrification rate data are presented here in the table below. To allow side by side comparison, we also include side by side results at three different battery price levels.

Table S5. Comparison of electrification rate of total fleet VMT using different data sets.





Comparison
for battery
price at
\$100/kWh



References

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7. Cai W, Wang C, Wang K, Zhang Y, Chen J. Scenario analysis on CO₂ emissions reduction potential in China's electricity sector. *Energy Policy* 2007;35(12): 6445-56.