**Strategy Overview and Current System Analysis**

**Objective:** To increase profitability of the Saint Paul EV Spot Network by implementing a demand-based pricing structure aligned with customer elasticity and utility costs.

**Step 1: Understanding Charging Patterns (Data Source: Excel Sheet)**

**How This Works:** Each row in the dataset includes a start timestamp (e.g., 2024-04-03 14:35:12) showing when a charging session began. We extract the **hour** portion of this timestamp to determine which part of the day the user started charging.

We then group sessions into the following 5 time-of-day categories:

* **Early Morning (12AM–6AM)**
* **Morning (6AM–12PM)**
* **Afternoon (12PM–6PM)**
* **Evening (6PM–9PM)**
* **Night (9PM–12AM)**

This categorization lets us track behavioral patterns and determine which hours are popular or underused. The assumption is that the start time reflects the user’s intended usage window, which is valid for public EV stations with time-based turnover.

**File:** EVchargingdata.xlsx **Sheet Used:** Saint Paul 2024 Public

**R Code Used to Extract and Classify: (This code will be included if needed)**

* Extracted session start times from the “start” column.
* Classified sessions into 5 time-of-day bins using hour(start).
* Counted number of sessions per time block.

**Resulting Session Volumes:**

|  |  |
| --- | --- |
| **Time of Day** | **Session Count** |
| Early Morning | 15,087 |
| Morning | 2,113 |
| Afternoon | 24,597 |
| Evening | 13,441 |
| Night | 12,764 |

**Step 2: Current Pricing and Profit Analysis**

**Pricing Source:** EV Spot Network Memo & Xcel Time-of-Day Plan

|  |  |  |  |
| --- | --- | --- | --- |
| Time Period | Rate ($/kWh) | Xcel Energy Cost ($/kWh) | Notes |
| On-Peak (9AM–9PM) | $0.25 | $0.21 (Oct–May) / $0.26 (Jun–Sep) | Applies to Morning, Afternoon |
| Off-Peak | $0.23 | $0.05 | Applies to Evening, Night, Early Morning |

**Current Profit Calculation:** Assumes average usage of 1 kWh per session for simplicity.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time of Day | Sessions | Price | Energy Cost | Revenue ($) | Cost ($) | Profit ($) |
| Early Morning | 15,087 | 0.23 | 0.05 | 3,469.99 | 754.35 | 2,715.64 |
| Morning | 2,113 | 0.25 | 0.21 | 528.25 | 443.73 | 84.52 |
| Afternoon | 24,597 | 0.25 | 0.21 | 6,149.25 | 5,165.37 | 983.88 |
| Evening | 13,441 | 0.23 | 0.05 | 3,091.43 | 672.05 | 2,419.38 |
| Night | 12,764 | 0.23 | 0.05 | 2,935.72 | 638.20 | 2,297.52 |
| **Total** | 68,002 |  |  | **16,174.64** | **7,673.70** | **8,500.94** |

**Price Adjustment Plan and Profit Optimization**

**Step 3: Elasticity-Driven Pricing Plan**

Using observed demand behavior and estimated elasticity:

|  |  |  |  |
| --- | --- | --- | --- |
| Time of Day | Elasticity | Action | New Price |
| Early Morning | –1.7 | Decrease 5% | $0.218 |
| Morning | –0.5 | Increase 5% | $0.263 |
| Afternoon | –0.8 | Hold | $0.25 |
| Evening | –1.3 | Decrease 2% | $0.225 |
| Night | –1.6 | Decrease 5% | $0.218 |

**Step 4: Apply Time-of-Day Electricity Costs**

**Updated Xcel On-Peak/Off-Peak Cost Breakdown:**

* **On-Peak (9AM–9PM):**
  + **Summer (Jun–Sep):** $0.26/kWh
  + **Winter (Oct–May):** $0.21/kWh
* **Off-Peak (9PM–9AM):** $0.05/kWh (year-round)

Assuming billing month is **October (Winter)**, we apply:

* **$0.21** for Morning & Afternoon
* **$0.05** for other periods

**Step 5: Simulated Profit with New Pricing**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time of Day | New Price | Sessions | New Sessions | Revenue | Cost | Profit |
| Early Morning | $0.218 | 15,087 | 16,551 | 3,609.12 | 827.56 | 2,781.56 |
| Morning | $0.263 | 2,113 | 2,060 | 541.78 | 432.60 | 109.18 |
| Afternoon | $0.25 | 24,597 | 24,597 | 6,149.25 | 5,165.37 | 983.88 |
| Evening | $0.225 | 13,441 | 13,862 | 3,119.03 | 693.10 | 2,425.93 |
| Night | $0.218 | 12,764 | 14,122 | 3,079.60 | 706.10 | 2,373.50 |
| **Total** |  | 68,002 | 71,192 | **16,498.78** | **7,824.73** | **8,674.05** |

**Net Profit Gain:**

* New Profit = $8,674.05
* Current Profit = $8,500.94
* **Net Increase = $173.11 (+2.04%)** ✅

**Conclusion: Why This Plan Works**

This pricing plan is rooted in core economic principles of demand elasticity and marginal analysis:

* **Elastic Demand (Early Morning, Night):** When demand is elastic (|ε| > 1), lowering prices leads to a proportionally greater increase in quantity demanded. This raises total revenue and encourages underused time slots to become more active. In our case, charging demand during Early Morning and Night increased significantly after price reductions.
* **Inelastic Demand (Morning):** When demand is inelastic (|ε| < 1), raising prices causes only a small drop in quantity demanded. This means revenue can increase despite higher prices. Since Morning sessions are relatively insensitive to price, a 5% price increase yields more revenue without major usage loss.
* **Marginal Profit and Cost Efficiency:** The marginal cost of electricity is much lower during off-peak times ($0.05/kWh). Therefore, even when prices are cut slightly, profit margins remain high in those periods. This ensures efficiency in aligning pricing with both consumer behavior and utility costs.
* **Overall Outcome:**
  + Charging sessions increased by ~4.7%
  + Net profit rose by **+2.04%**
  + The strategy captures untapped demand without sacrificing profit during peak hours

This plan therefore balances consumer incentives, revenue growth, and operational cost structure in a way that maximizes economic surplus for the city-run EV network.

**Recommendation**

Adopt this elasticity-aligned pricing model as a **pilot program** under a public-facing promotion called **“Happy Hour Charging”** — a branded incentive where prices are lowest during high-elasticity, off-peak hours (e.g., 9PM–6AM).

**Marketing Strategy:**

* **Campaign Name:** "Happy Hour Charging"
* **Slogan:** "Charge more, pay less – every night from 9PM to 6AM!"
* **Channels:** City social media, email lists, EV user apps, physical signage at chargers
* **Incentive Messaging:** Emphasize affordability, availability, and the environmental benefit of nighttime grid usage
* **Rollout:** Implement across selected hubs for 3 months and track changes in session volumes and revenues

**Why It Works:** This campaign frames price reductions as a benefit to users (not cost saving for the city), increases volume during underused periods, and enhances public perception of EV infrastructure.

After 3 months, use session data to assess behavior shifts and refine pricing accordingly. This method is not only economically optimal but also publicly engaging and politically attractive.