To get to the bottom of why the waiting might be so high, we can evaluate each component constituting wait time individually

$$T_{wait} = T_{queue} + T_{process} + T_{availability}$$

1 Factor affecting T_{queue}

This is the time spent waiting in line before service begins.

Insufficient number of stations

Battery Smart: *40 drivers per station*[1]

gogoro: *45 drivers per station*[2]

Poor station location planning:

Uneven station distribution can causes congestion leading to high waiting time in some areas

Uneven demand distribution:

- Geographic: Some high traction areas might have more demand then others
- Time-based: Peak hours see heightened demand

2 Factor affecting T_{queue}

This is the time required to complete the battery swap

Operator dependency:

Single operator setup creates bottlenecks during peak times

Manual battery handling:

Since the operator manually retrives the batteries here, this can become a bottleneck during peak hours

*Self-service vending machine-style stations swap batteries in **6 seconds**, while Battery Smart stations take **2 minutes*** [3]

Payment process:

With most payments made in cash, the need to provide change can extend checkout time

Battery identification and sorting:

Unorganized labeling can lead to delays in locating the correct battery

2 Factor affecting $T_{availability}$

This is the time spent waiting for a battery to become available

Limited battery stock:

Overall low battery inventory in the cycle can restrict availability during high-demand periods

Limited charging capacity:

Insufficient charging ports can restrict the number of batteries ready for use

Long charging times:

Slow chargers can increase the time taken to prepare batteries for swaps

Towards Solutions...

Based on Battery Smart's business model and prioritization through an impact vs. importance analysis, our solution should focus on the following factors:

1. Even distribution of demand (Reducing T_{queue})
2. Availability of Batteries During Peak Hours (Reducing $T_{availability}$)

Resources: [1] [2] [3]