



Brad Boehler

President, Skyjack Inc.

Telematics and Data Ownership

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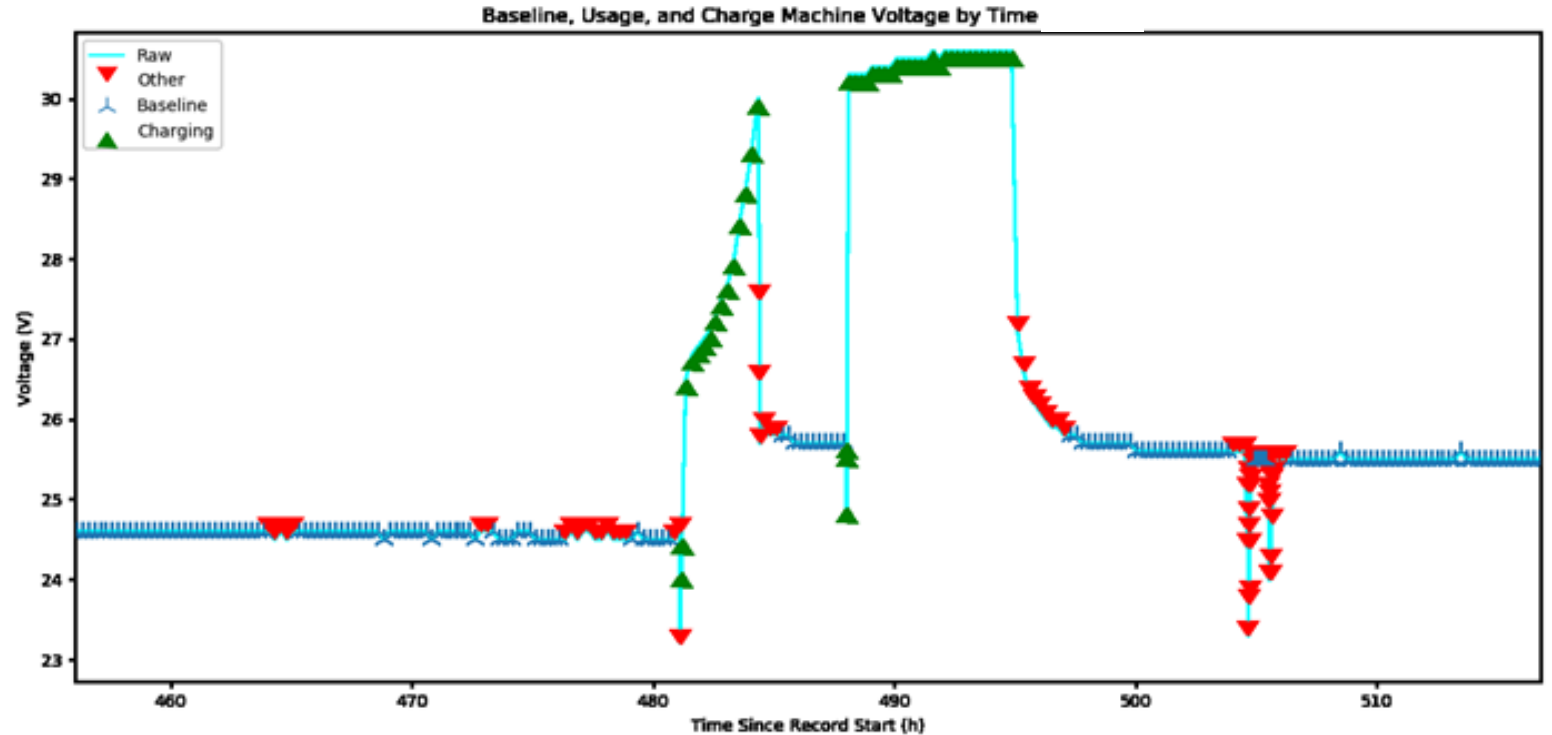


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Battery Telemetry

Agenda

- Baseline Analysis 
- Charging Analysis 
- Usage Data Analysis 
- Project Timeline
- Machine Learning Products

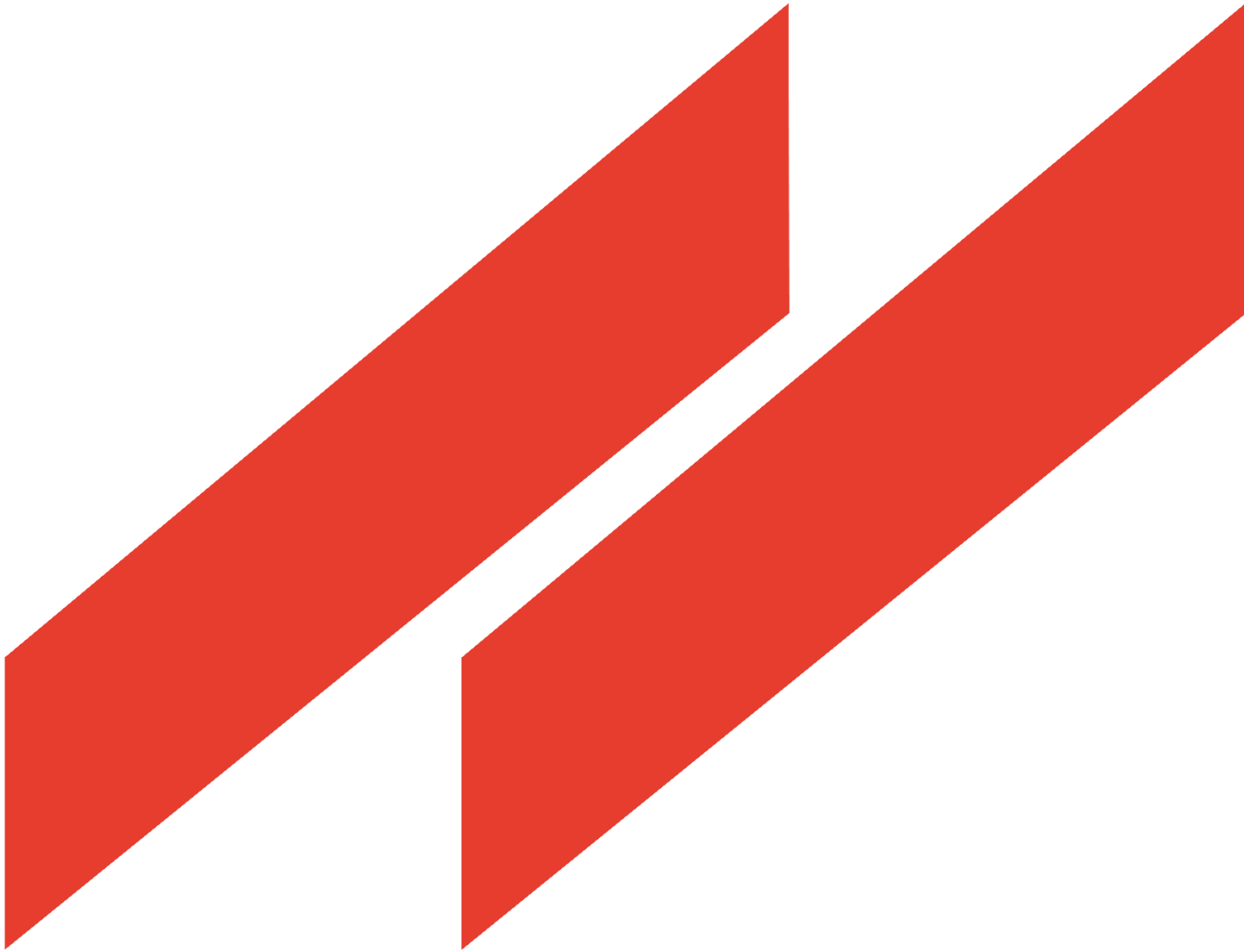


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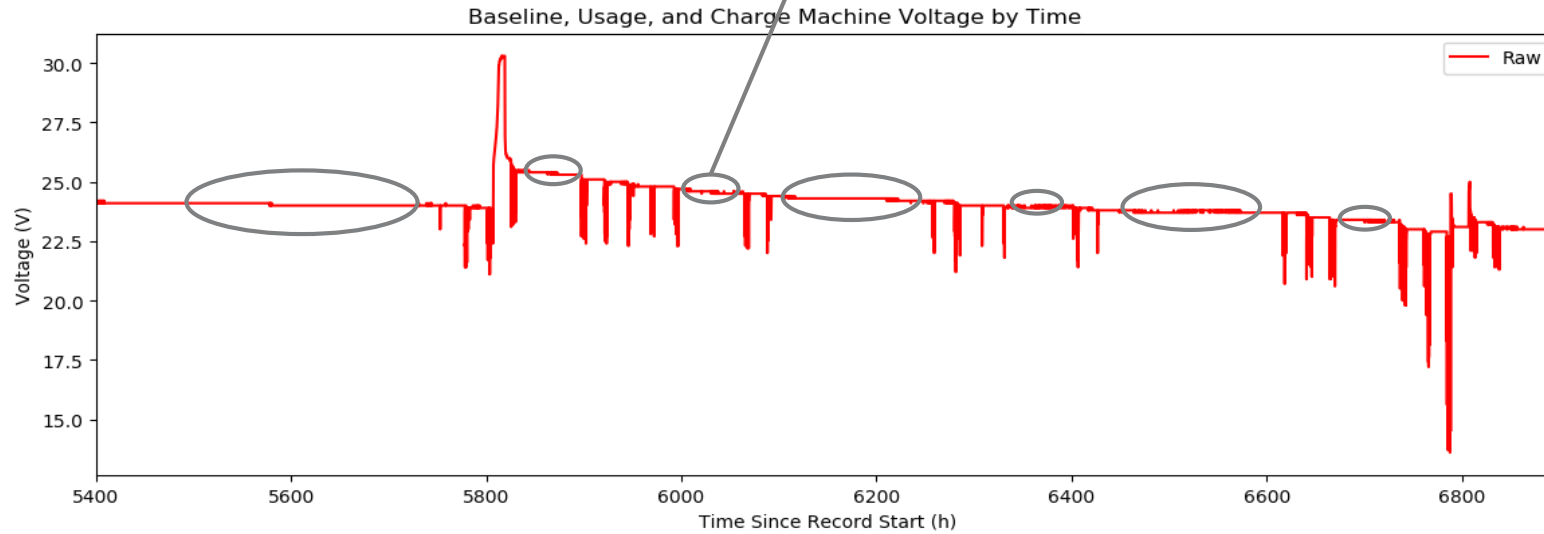
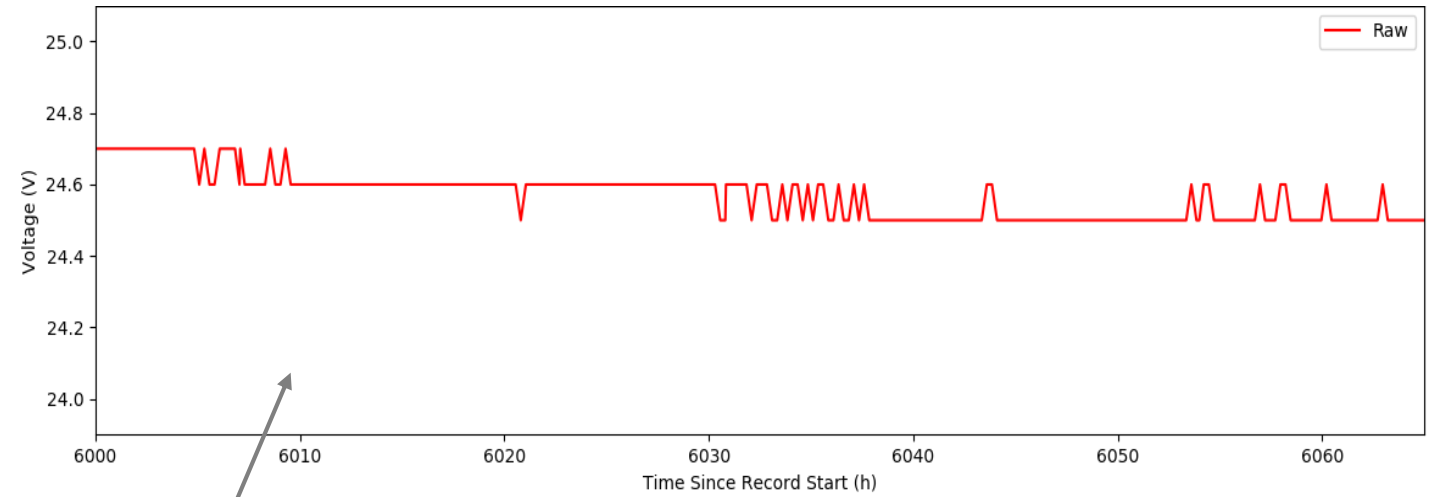
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Baseline Analysis

Case Study: Labelling Baseline Data



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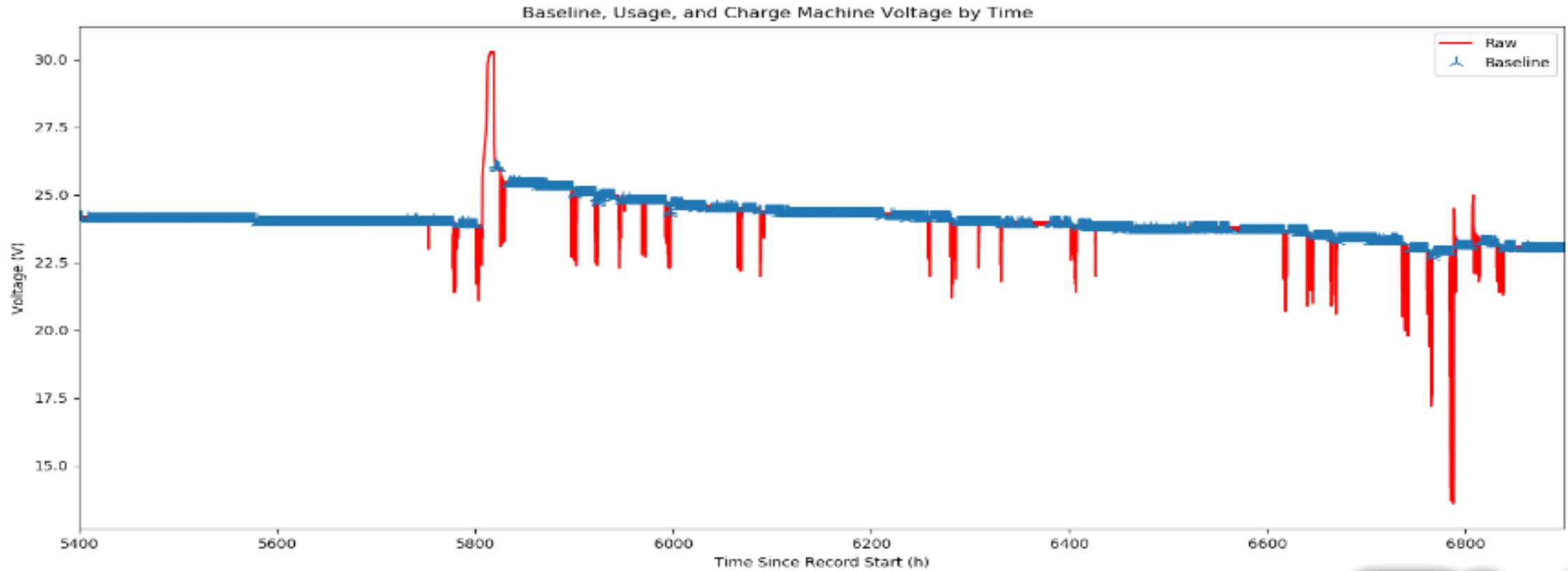
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Case Study:

Labelling Baseline Data



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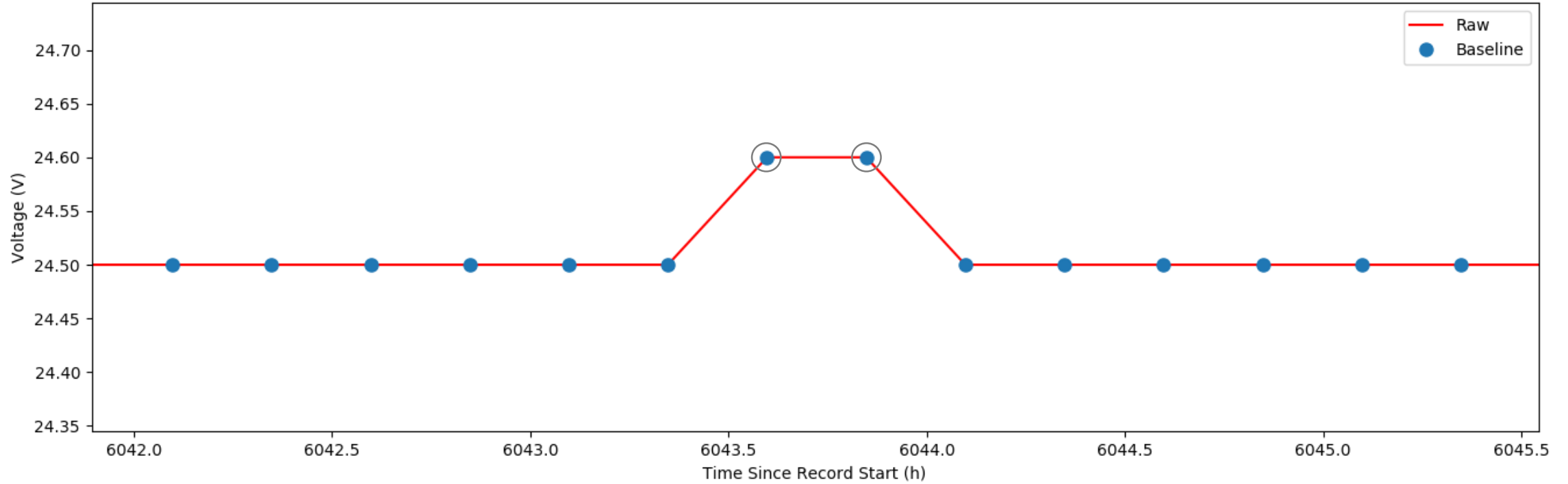
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Case Study:

Labelling Baseline Data

Baseline, Usage, and Charge Machine Voltage by Time



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Baseline Analysis

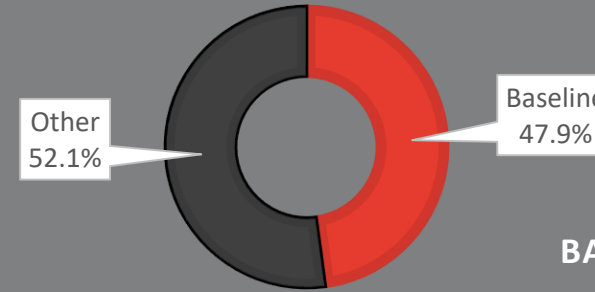
Baseline Detector

- Computationally Cheap
 - Potentially viable for edge computing
- Tuned for very high specificity: lossless

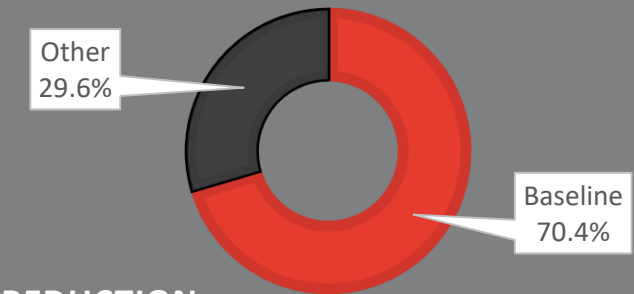
Data Compression

- Initial calculations show that approximately 29% of data can be removed without losing any important information.
- With a higher sampling rate, the percentage of baseline data that can be compressed will increase.

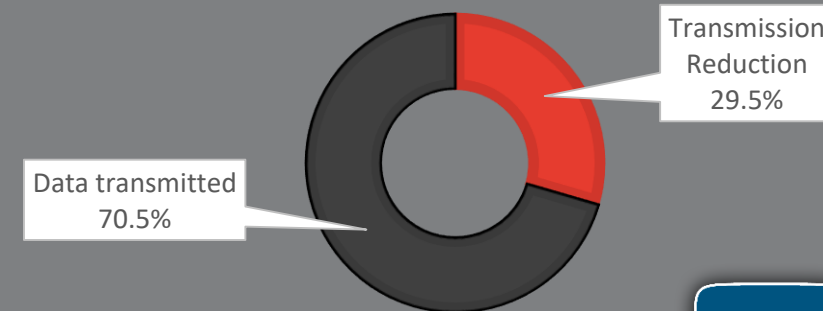
BASELINE PERCENTAGE OF DATA POINTS



BASELINE PERCENTAGE OF HOURS



DATA TRANSMISSION REDUCTION



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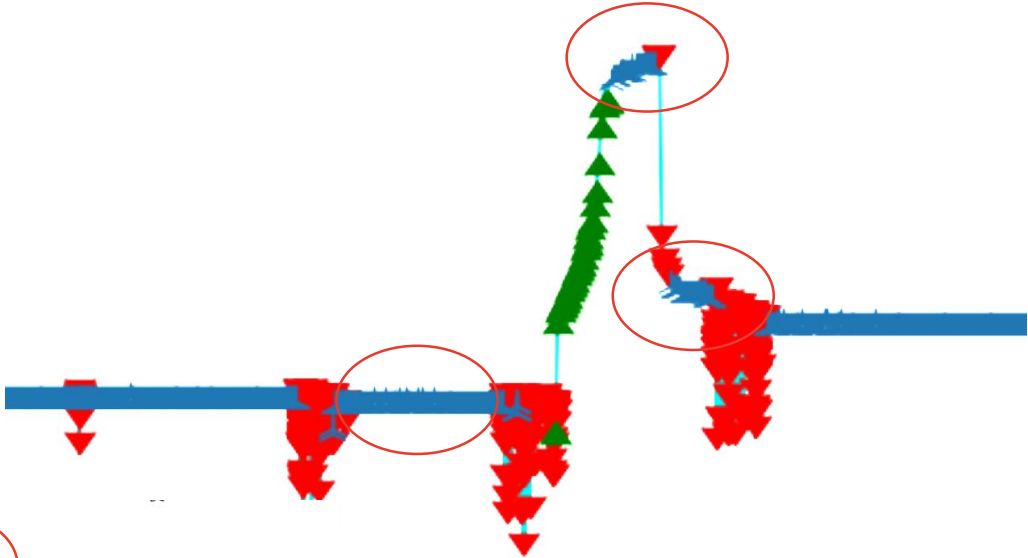
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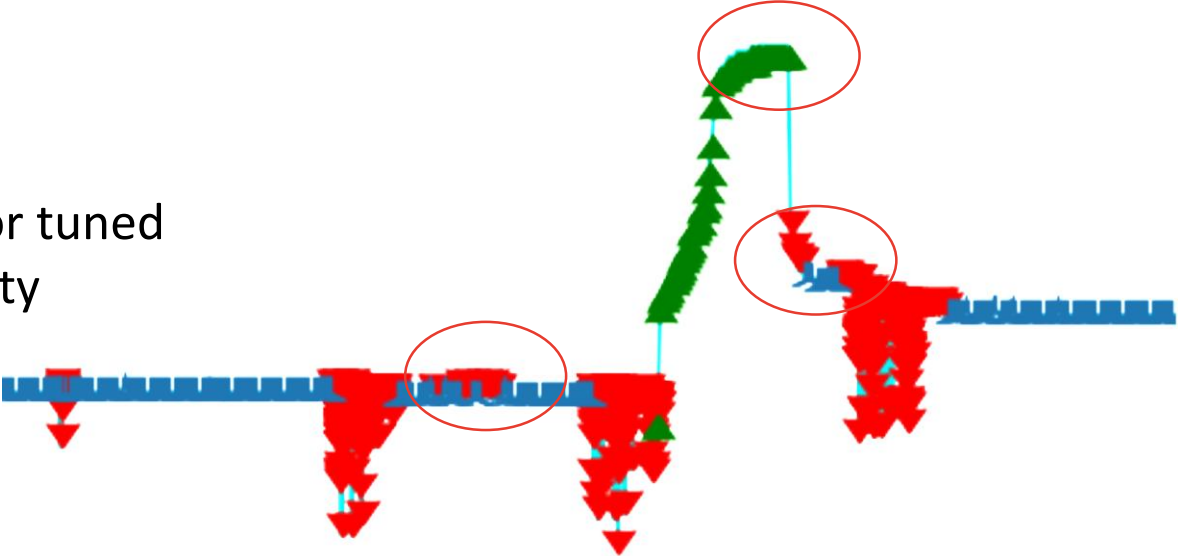
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Baseline Analysis

Baseline detector tuned for lower specificity



Baseline detector tuned for high specificity



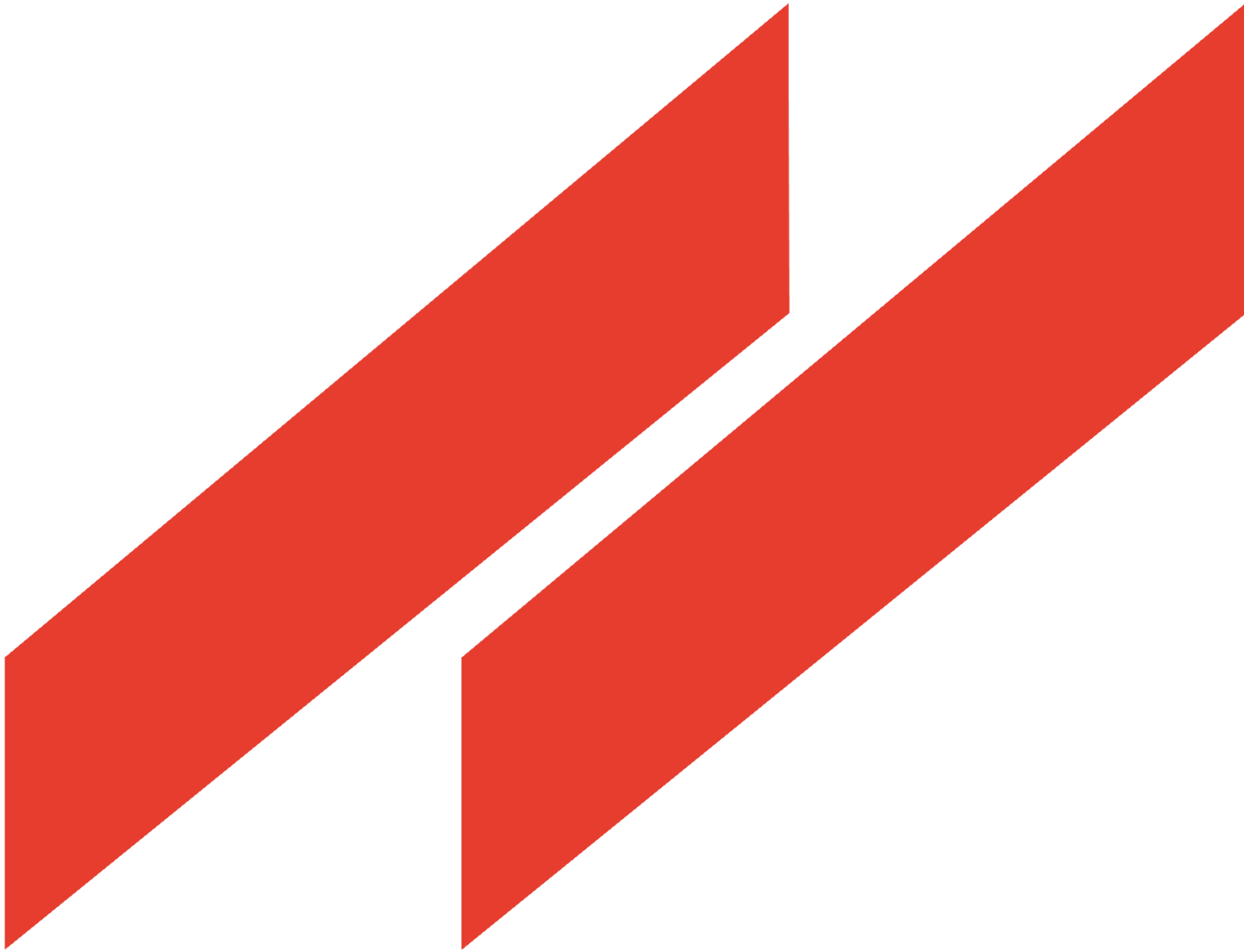
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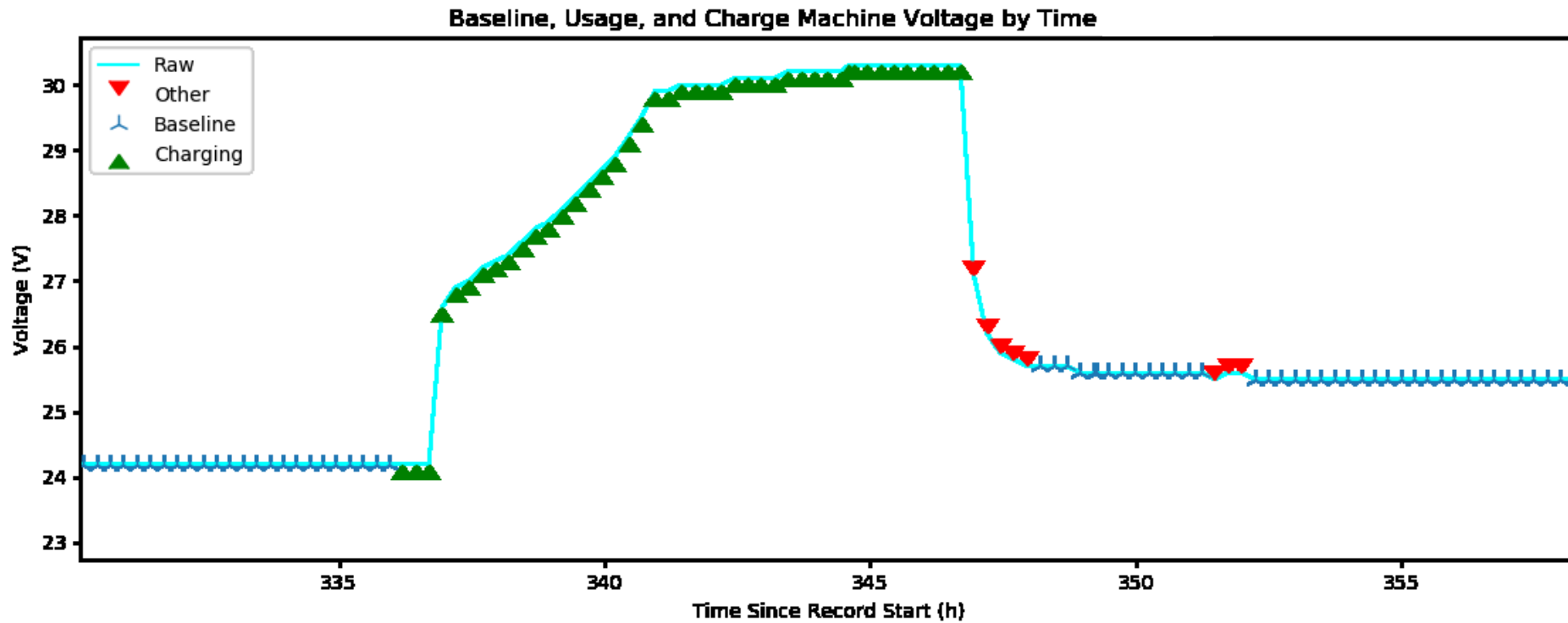
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Charge Analysis

Charge Analysis

Charge Curve: Voltage values over continuous charging session



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Case Study:

Charge Curve Algorithm

1. Identifying the start of a charge curve
2. Identifying the end of a charge curve
3. Handling split peaks
4. Handling voltage plateaus in the charge curve

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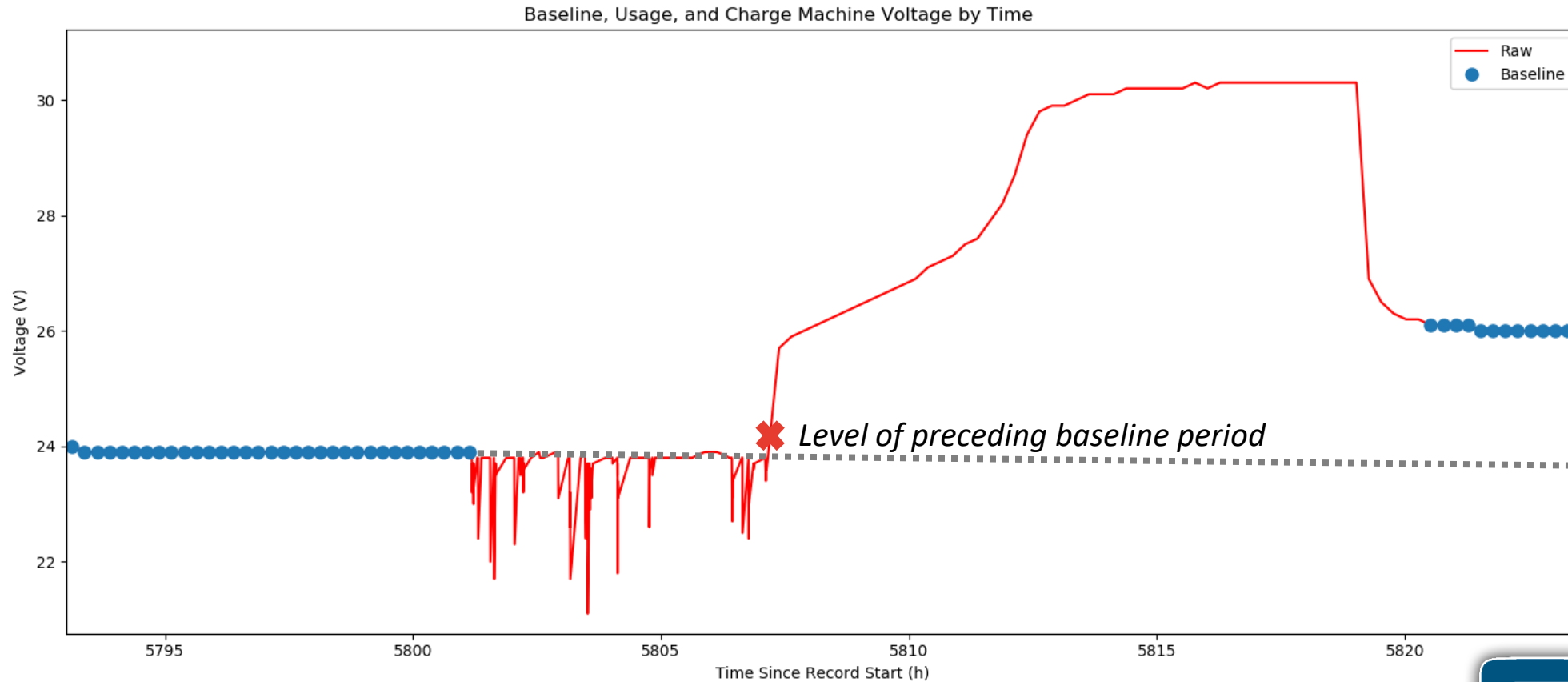
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Case Study:

1. Start of Charge – Initial Algorithm



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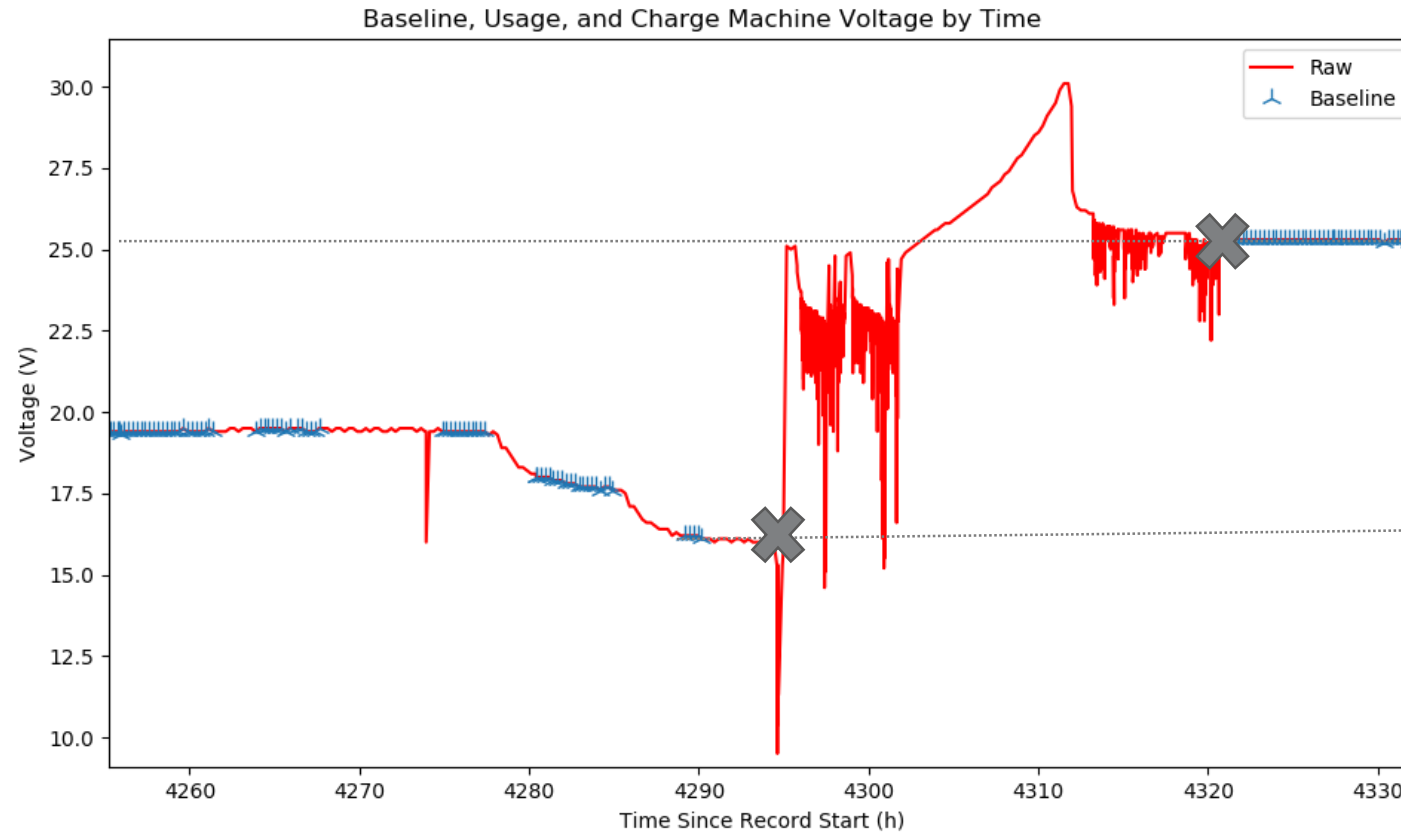
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Case Study:

1. Start of Charge – Initial Algorithm



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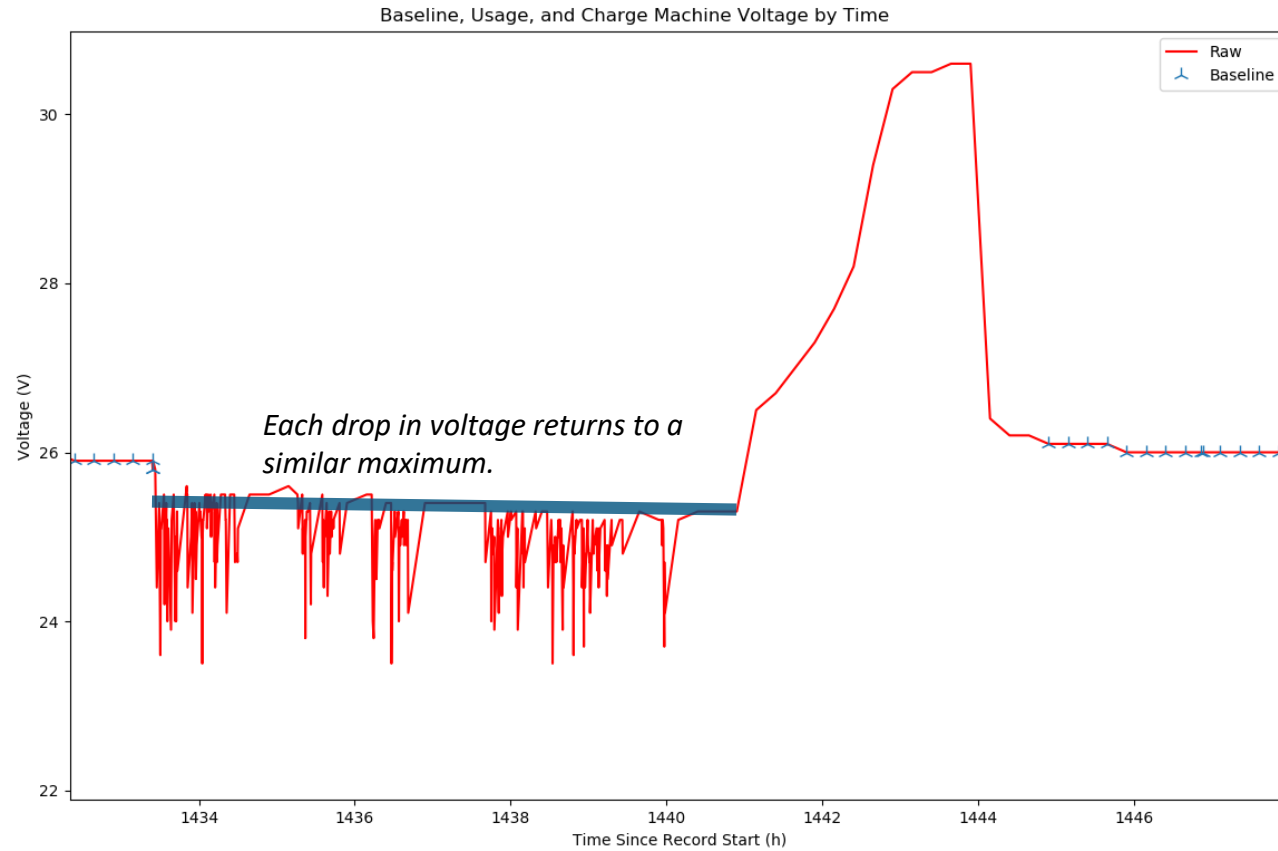
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Case Study:

1. Start of Charge – Improved Algorithm



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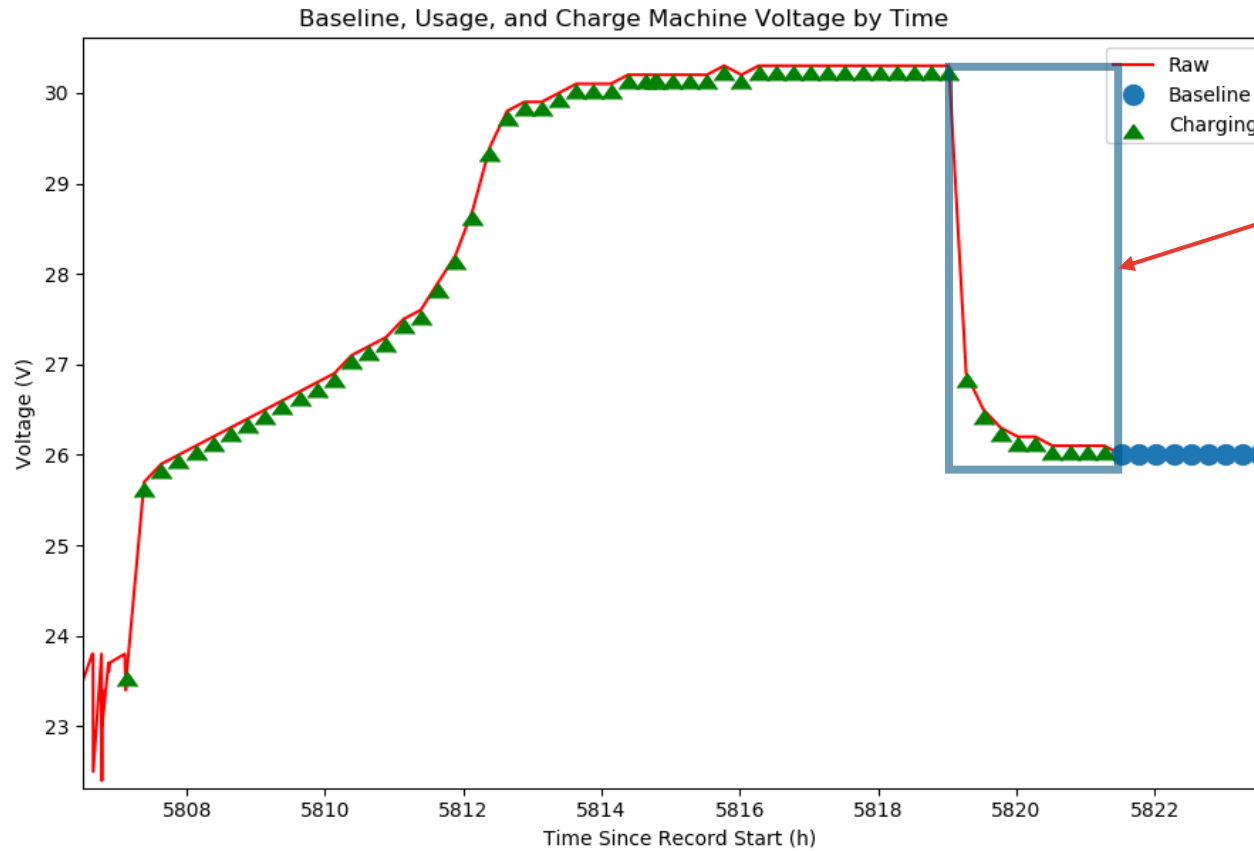
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Case Study:

2. End of Charge – Initial Algorithm



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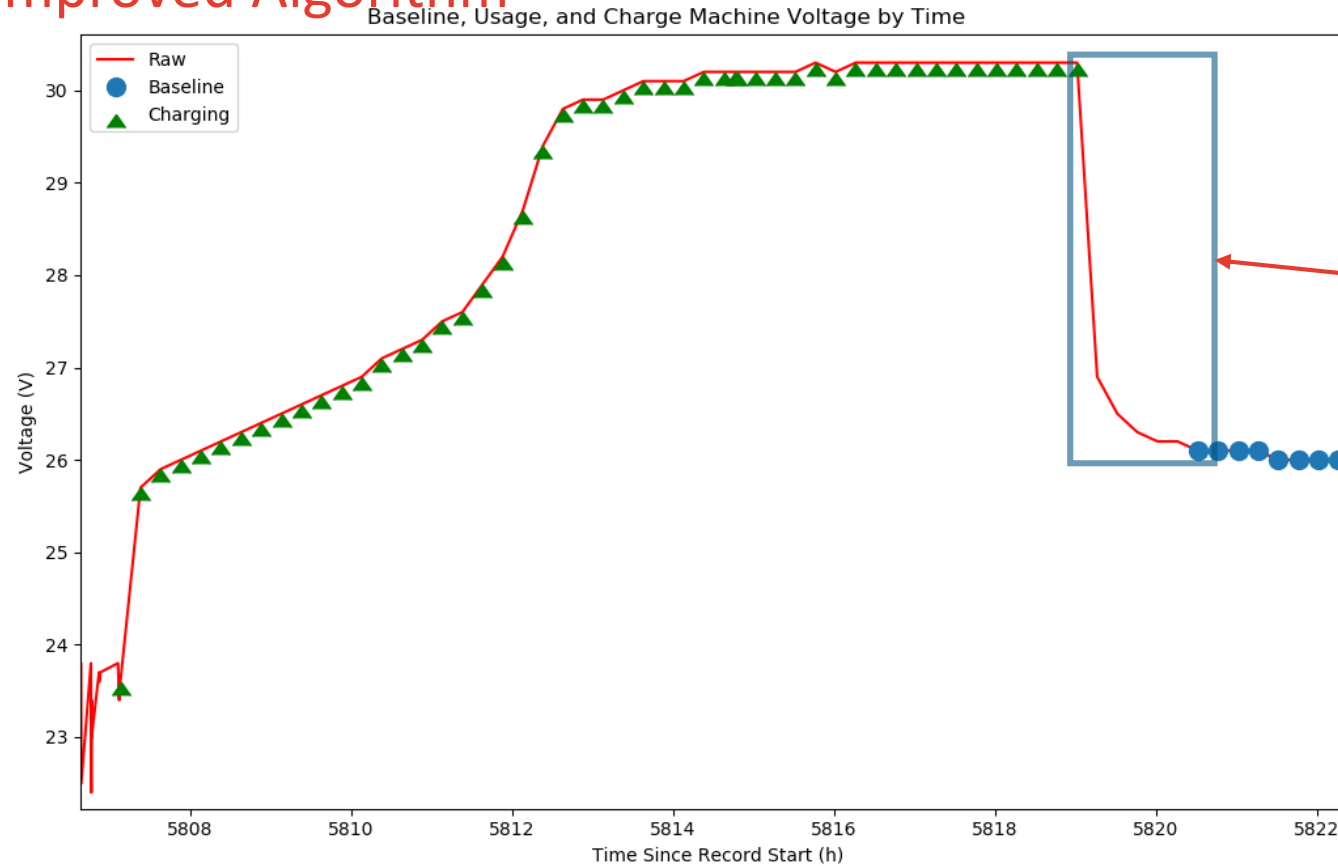
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Case Study:

2. End of Charge – Improved Algorithm



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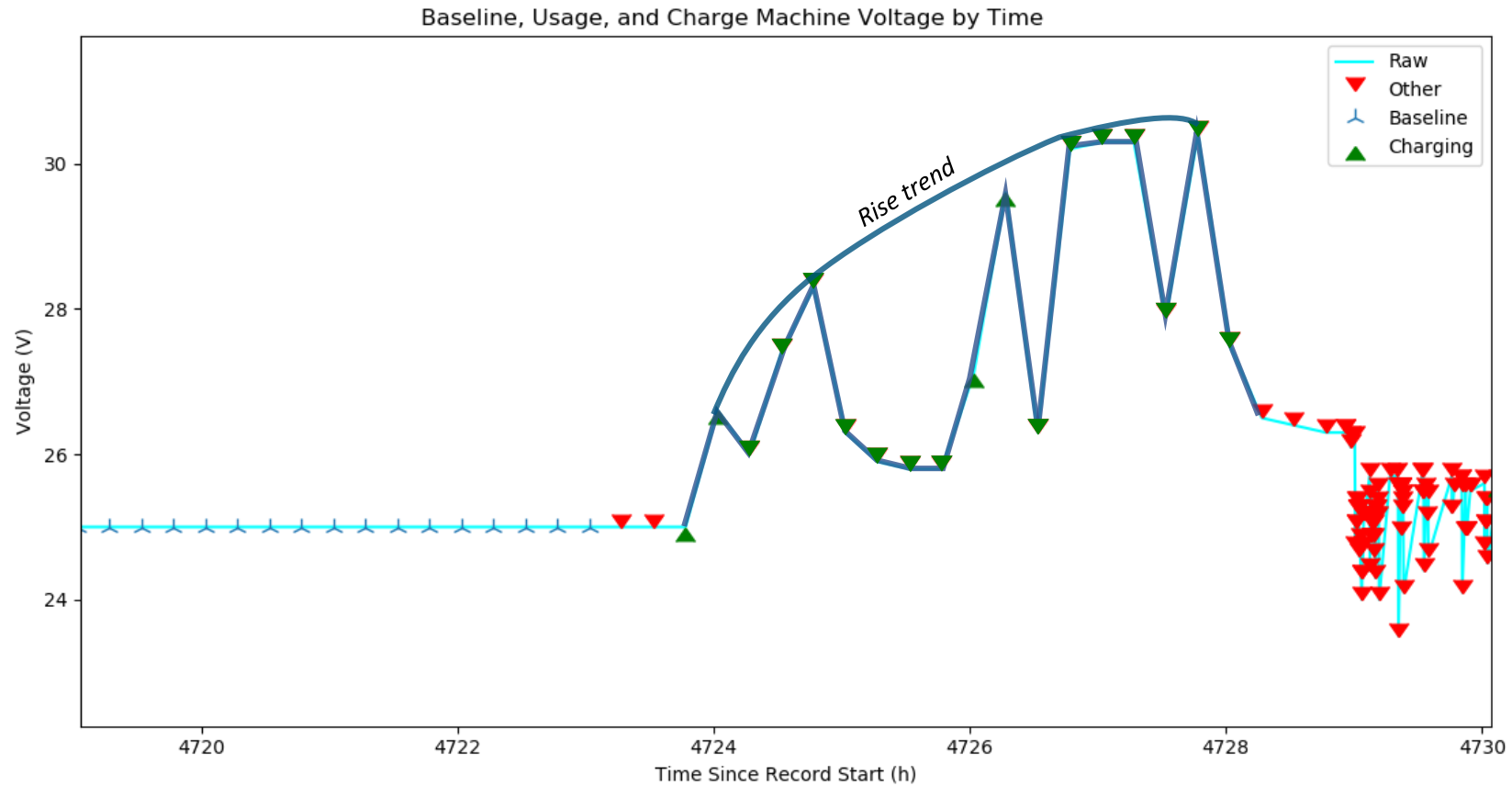
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Case Study:

3. Split Peaks



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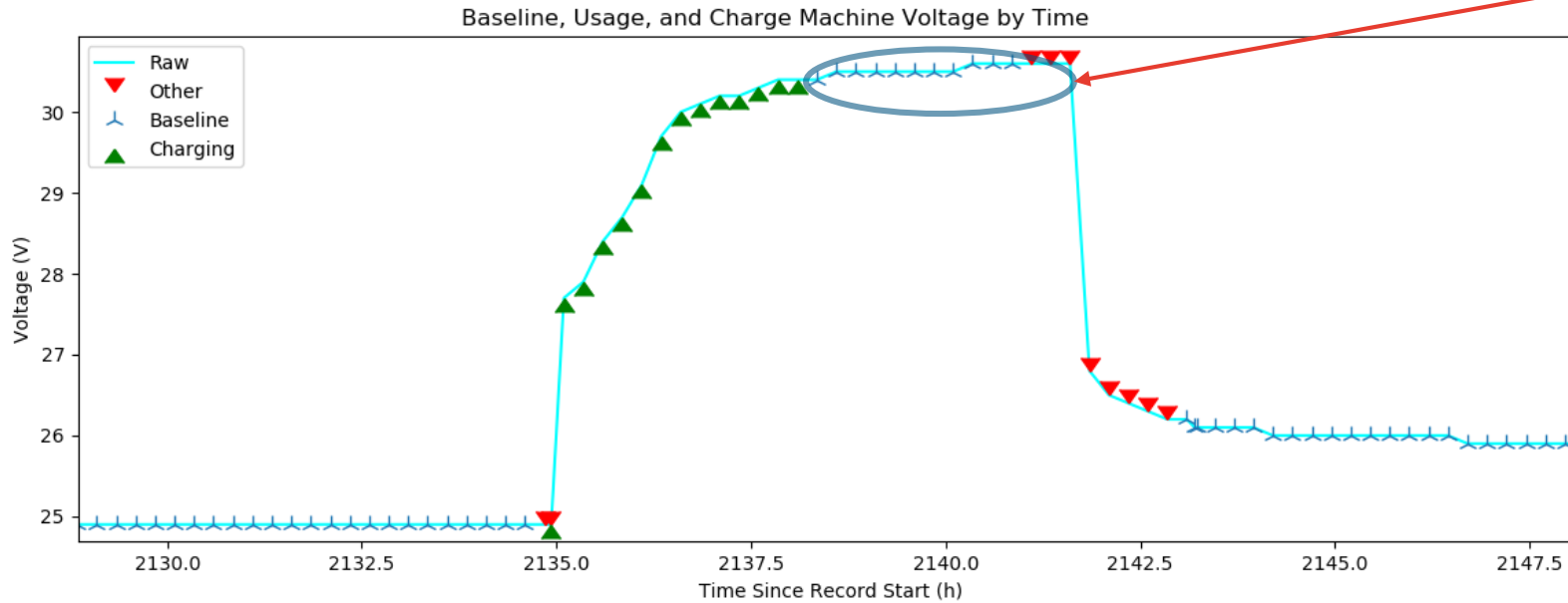
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Case Study:

4. Voltage Plateau – Initial Algorithm

Misdiagnosed charge data as baseline due to it leveling out at a high voltage



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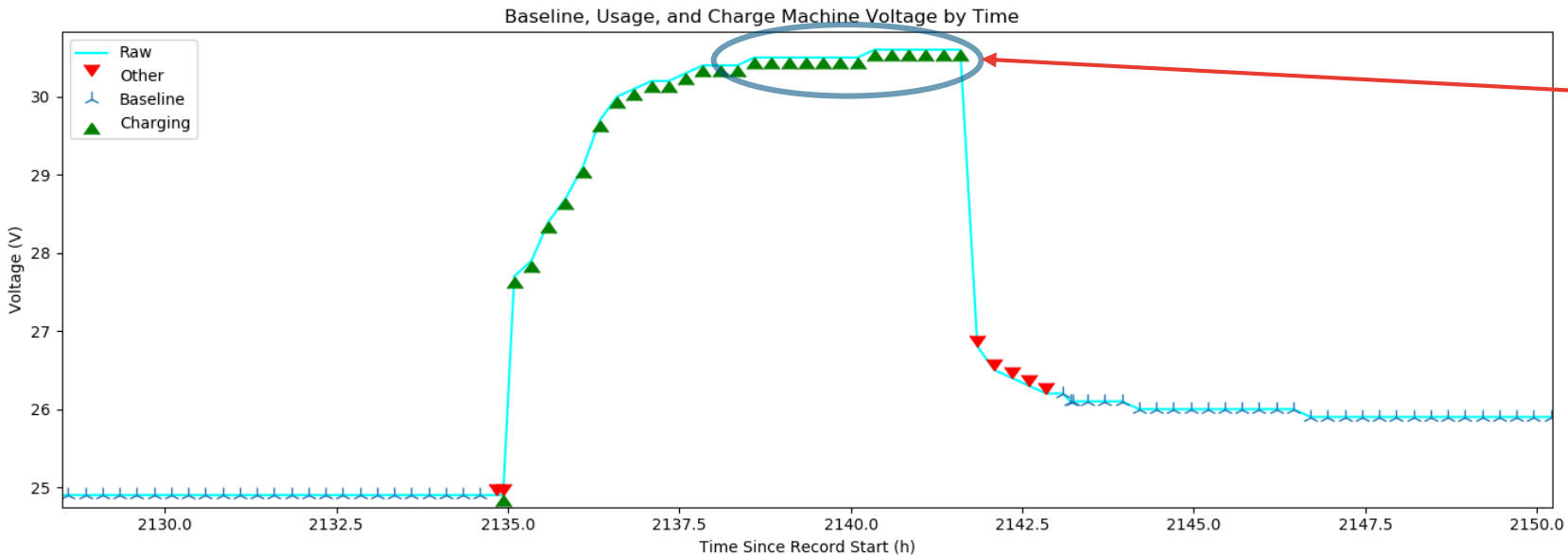
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Case Study:

4. Voltage Plateau – Improved Algorithm



Completed Charge Improved Algorithm:

To correct the issue, an ad hoc exception was imposed. This allows the voltage plateau to be correctly labeled as part of the charge curve.

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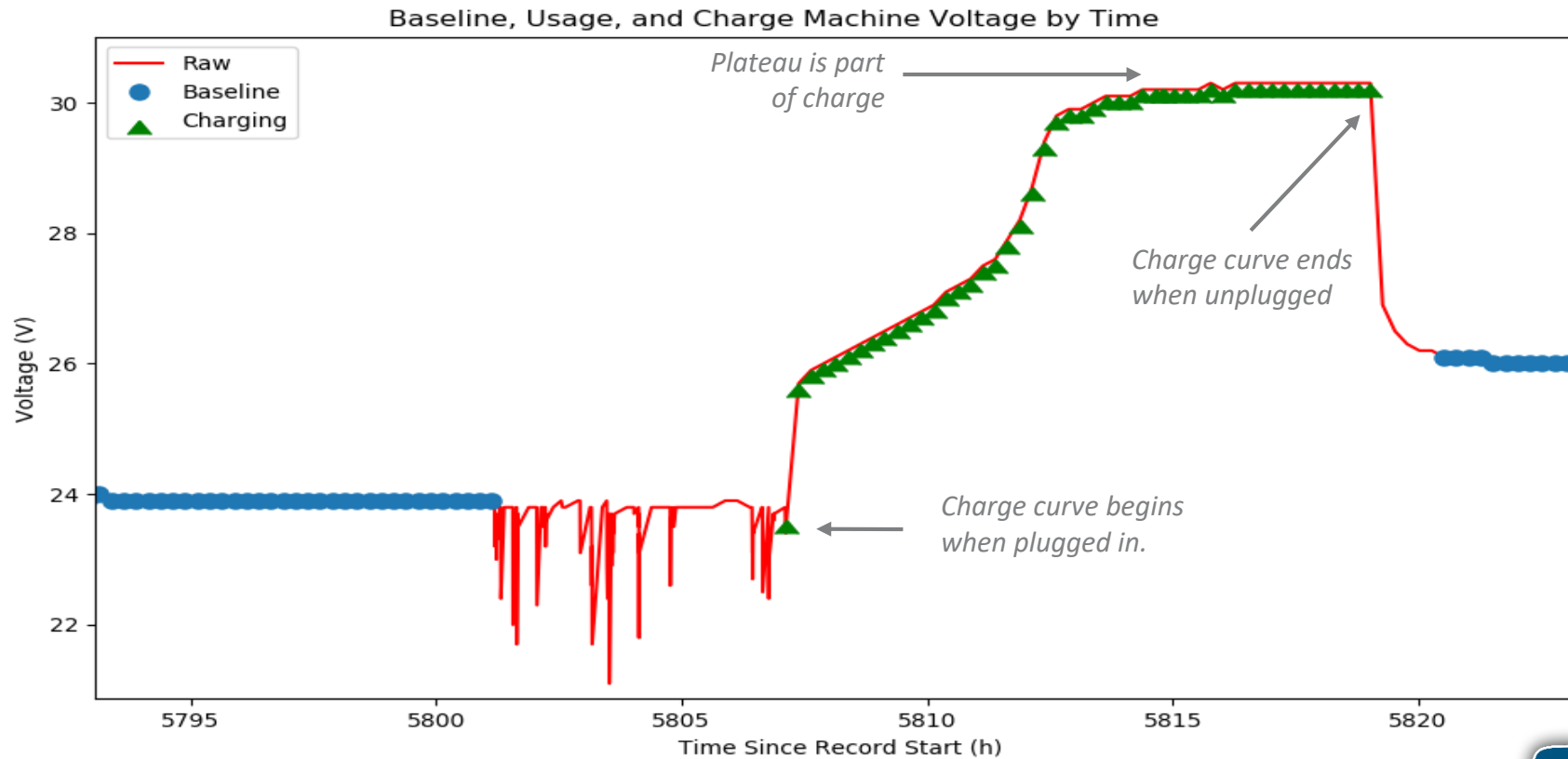
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Case Study:

Charge Curve Algorithm



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Charge Analysis

1

**MEDIAN NUMBER OF
CHARGES PER MONTH**

75%

CHARGES < 2.75 HRS

21.5

**AVERAGE TIME (DAYS)
BETWEEN FULL CHARGES**

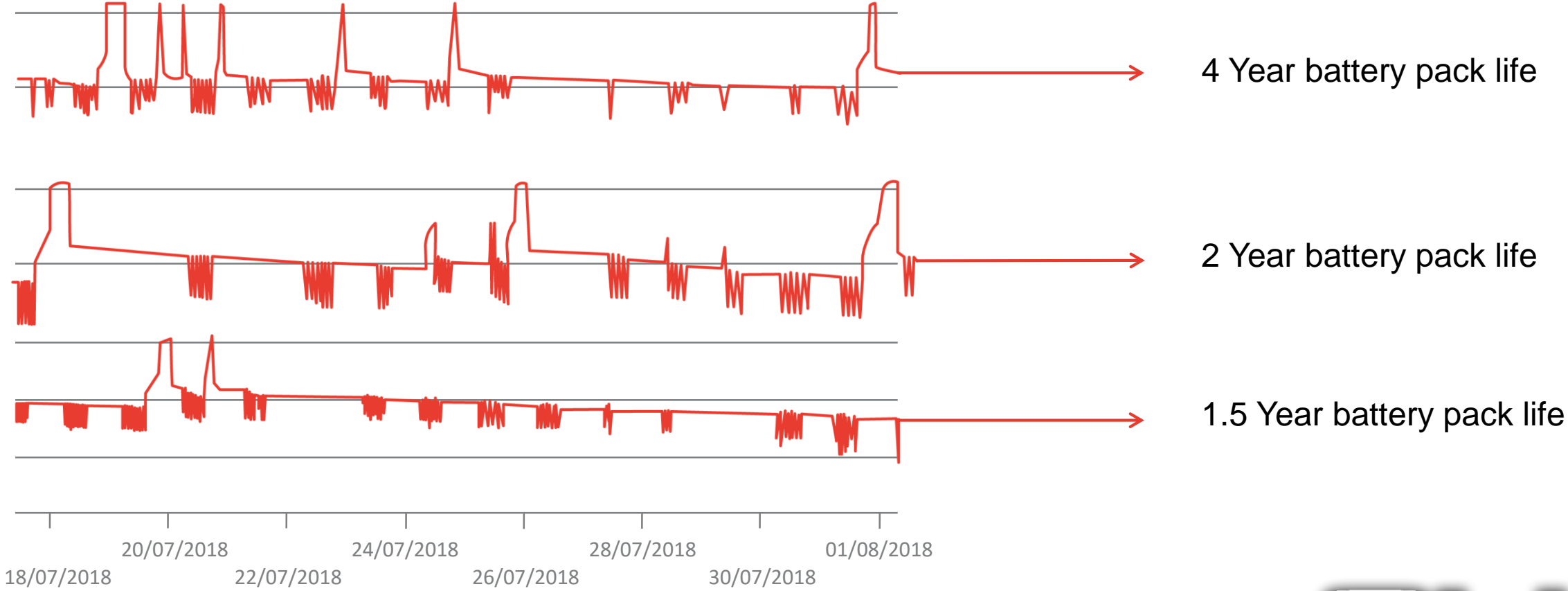
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Impact of Charging Management



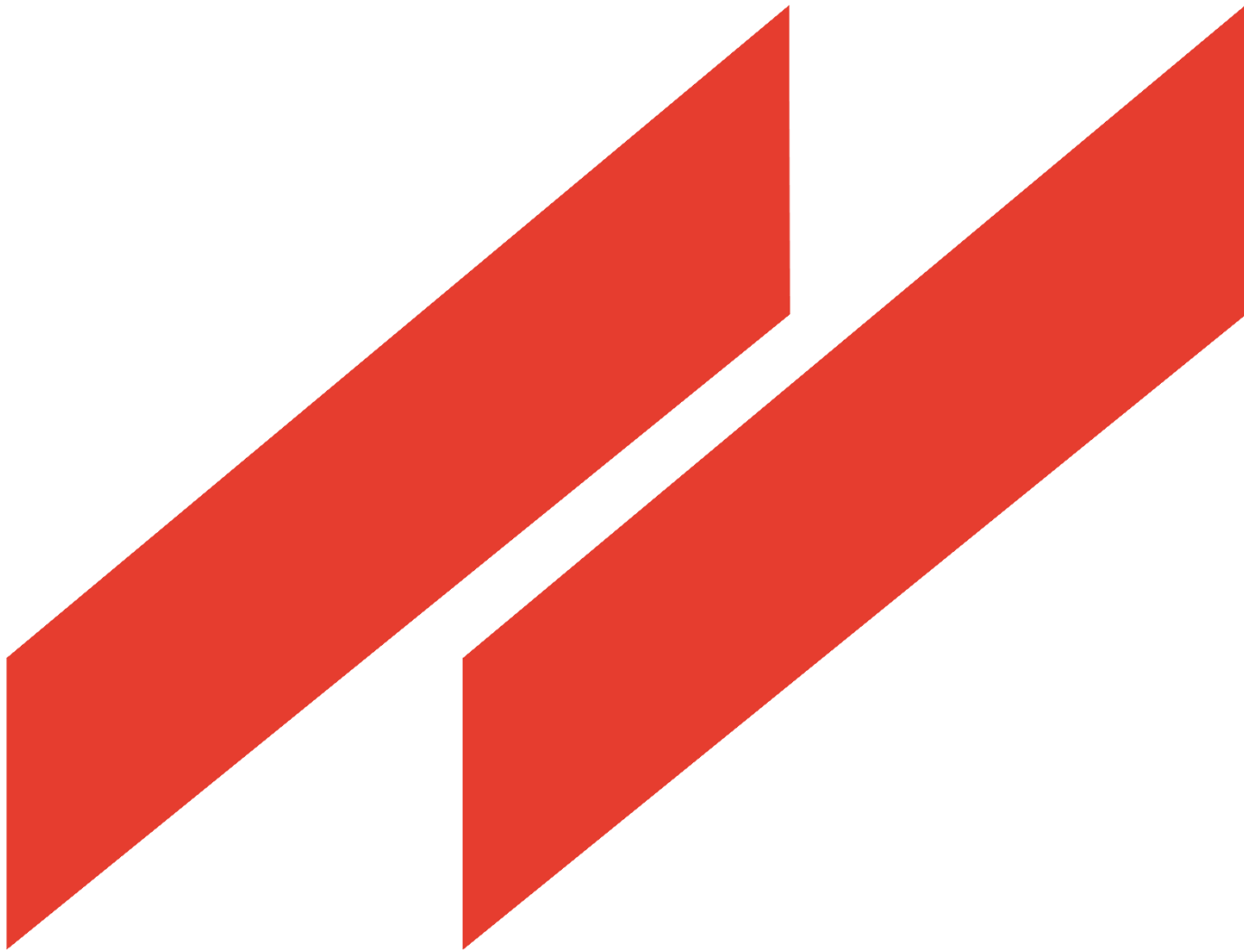
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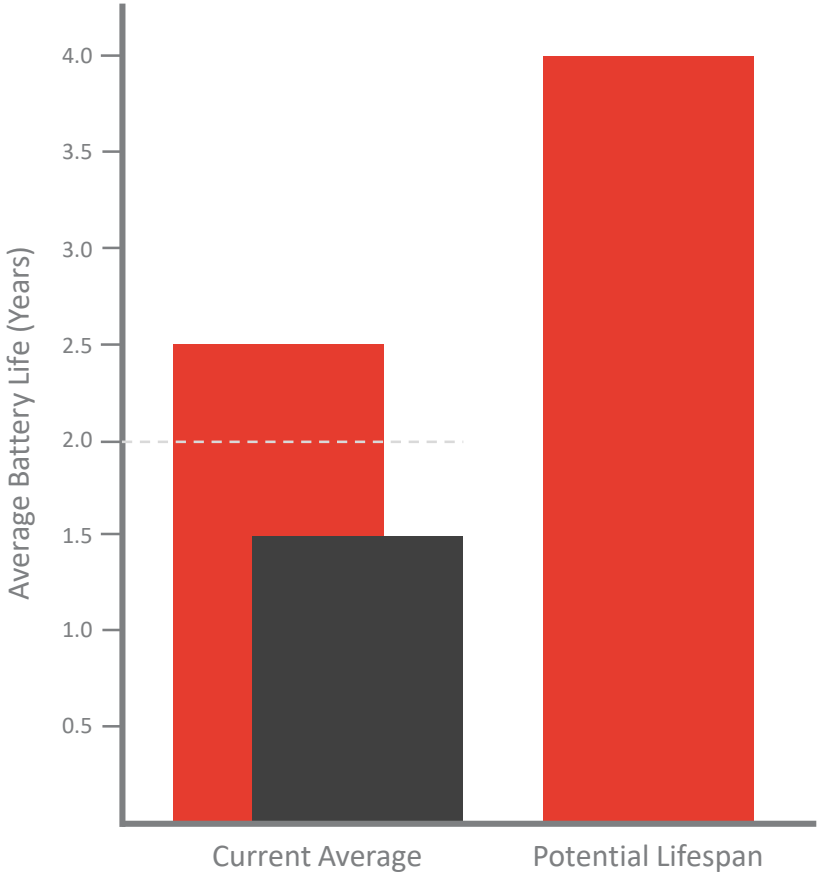
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Shiny bject Syndrome

Impact of Charging Behavior



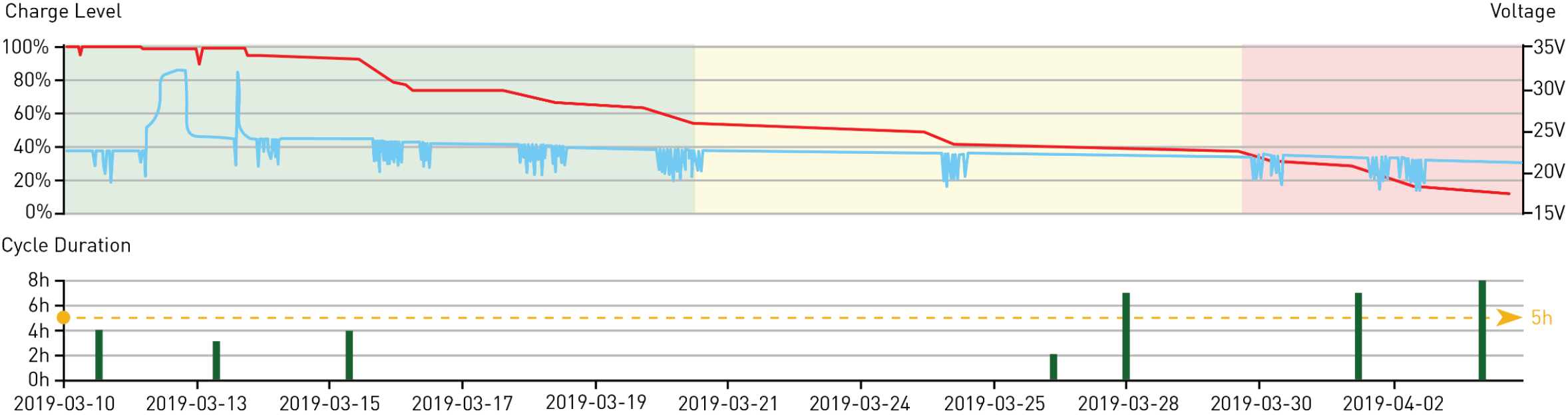
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Impact of Charging Behavior

■ Great Care
 ■ Insufficient Charge
 ■ Charge Immediately
 ○ Charge Level
 ○ Voltage
 ■ Cycles



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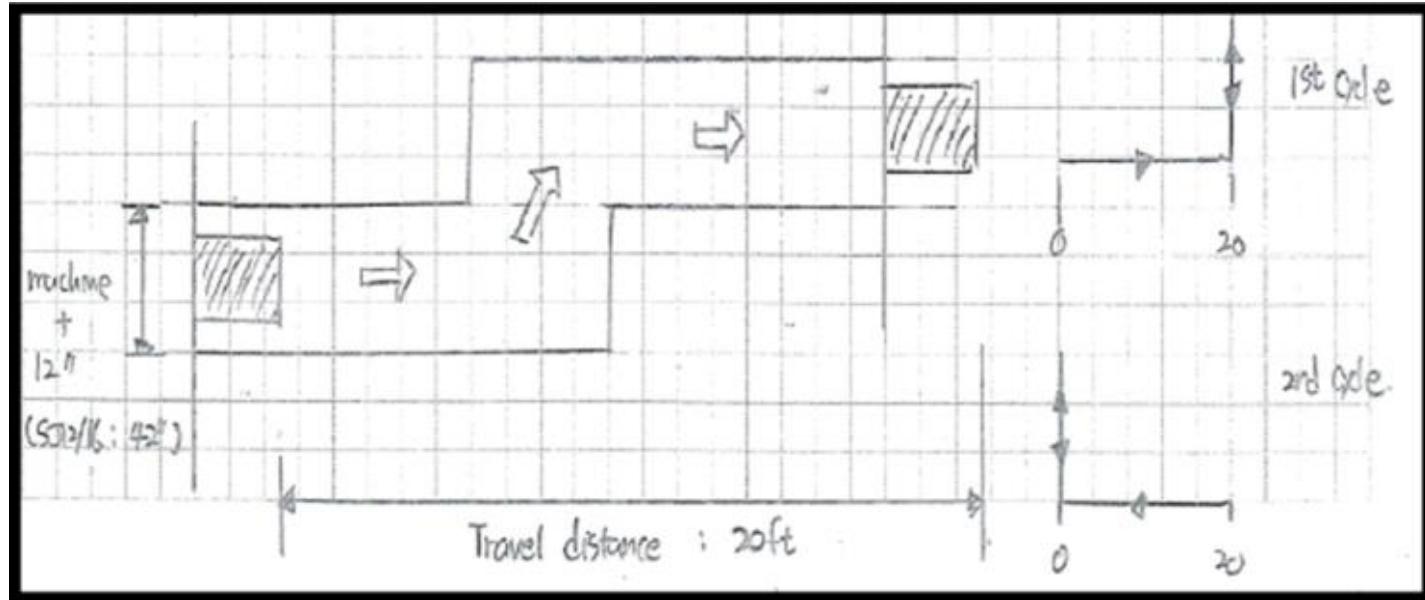
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Disrupting the Scissor Cycle

'The Cycle'



Cycle Details:

Load: 200lbs

Lift: 25 seconds

Drive: 11 Seconds

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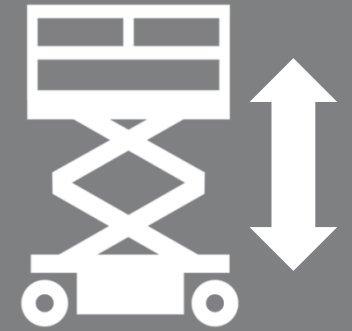
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Drive/Lift Analysis

Electric Scissor Sample

Input 1	= Pump run
Input 4	= Brake retracted (drive)
Input 1 Only	= Lift time
Input1 + Input 4	= Drive time



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Global Results



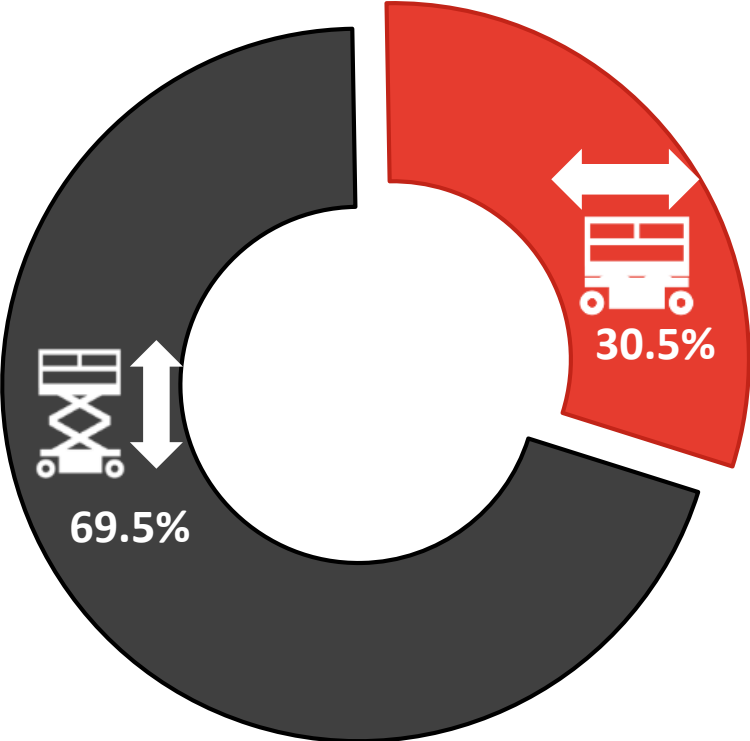
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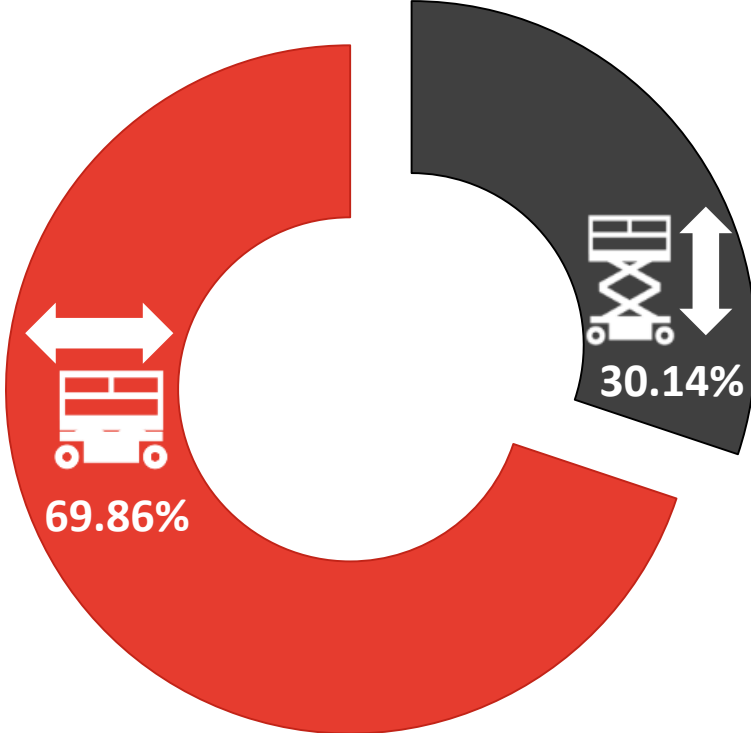


Duty Cycle Differential



'The Cycle'

vs.



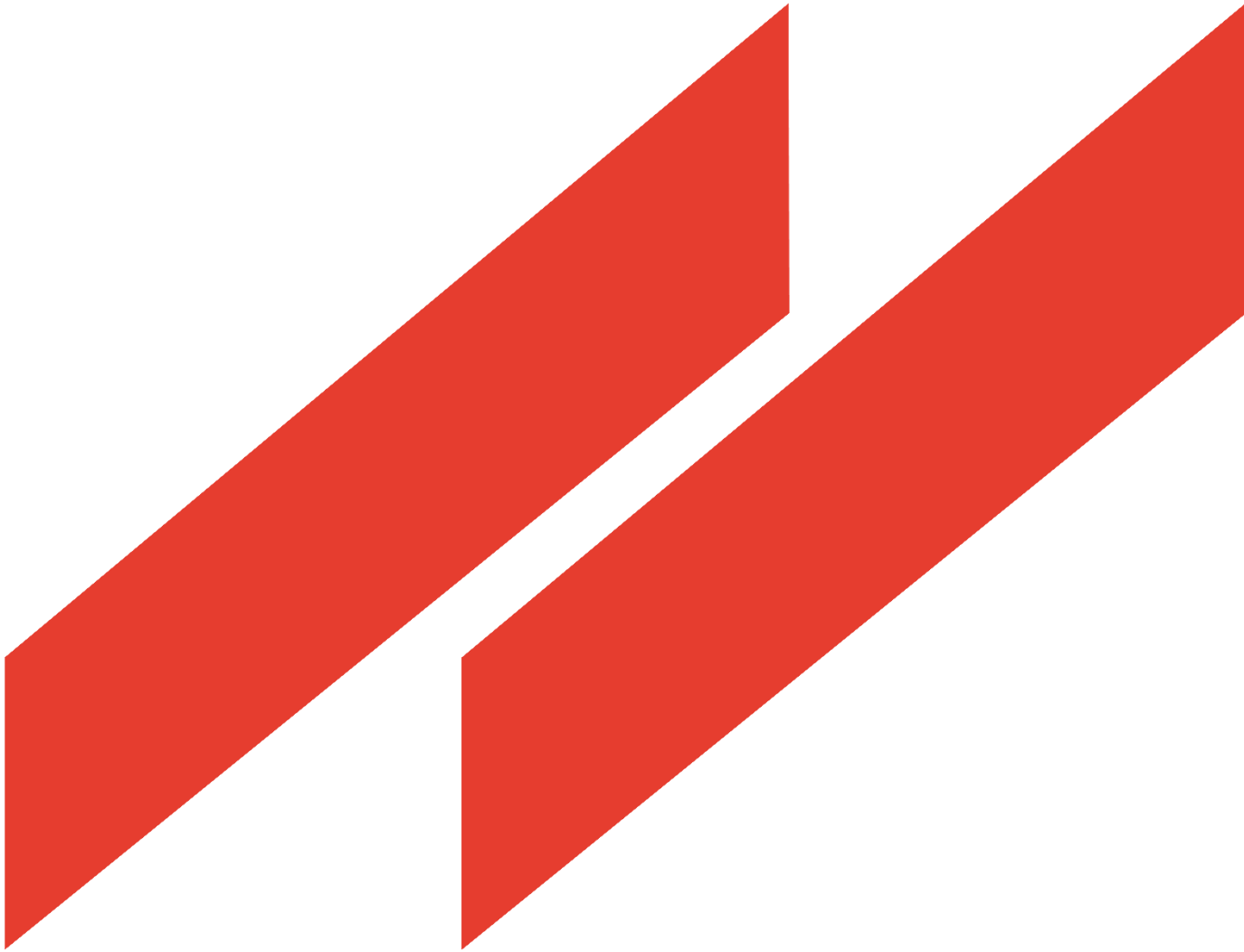
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Data Ownership

Data Privacy Questions

1. Where's the data coming from?
2. Who owns the data?
3. Who has access to the data?

SOME OEMS	SOME TECH COMPANIES	COMMENTATORS
OUR MACHINES!	OUR TECH!	HARD TO SAY!
WE DO!	WE DO!	TRICKY QUESTION!
WE DECIDE!	WHOEVER PAYS!	WE'LL SEE!

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Skyjack Digital Services, Data Privacy, Ownership & Governance

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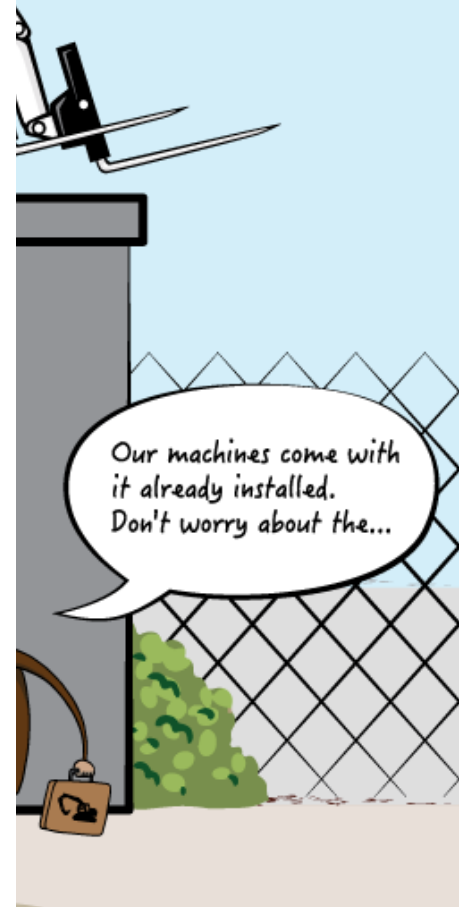
www.skyjack.com/data-privacy-governance

Version	Date Created	Date Uploaded	Approval	Signature
1.0	June 13, 2019		Brad Boehler, Skyjack President	

Document Scope

As we continue to move towards a state where telematics (or connected fleet data) is integrated into every construction rental business process, it's important that we (Skyjack) define our philosophy of data privacy, and clarify data ownership.

This document outlines Skyjack's approach to data ownership, data privacy, data access, and data governance.



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**50% of all Skyjack machines
this year will ship with
ELEVATE**

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Skyjack's Data Philosophy

- /// Data is owned by the rental company
- /// OPT-IN/ OPT-OUT option for limited Skyjack data access

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Thank You!
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