

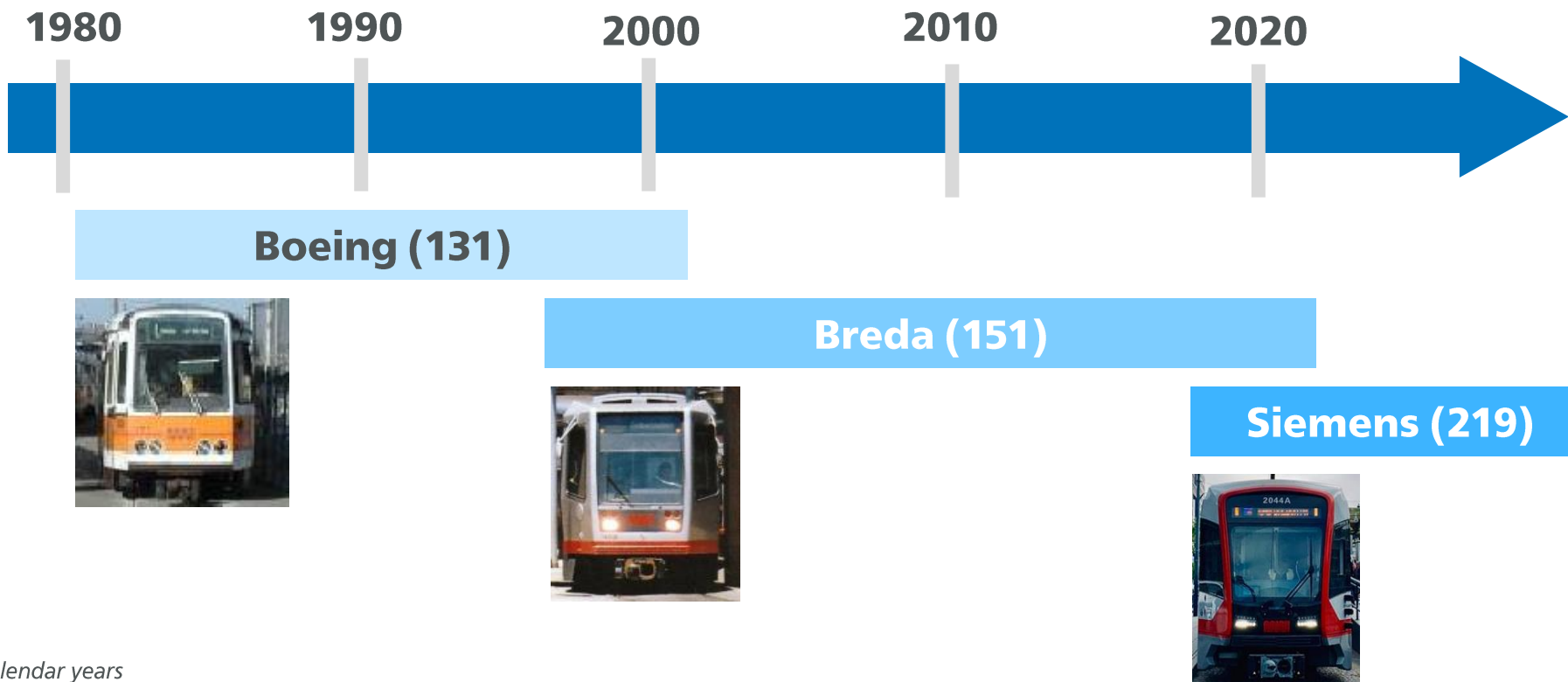


LIGHT RAIL VEHICLE PROCUREMENT PROGRAM

SFMTA Transit | August 2019

SFMTA Light Rail Fleet

- LRVs have a federally-mandated 25 year service life
- The Breda fleet will be eligible for retirement from 2021-2027
- SFMTA has expanded LRV mileage by 20% in last 5 years alone



Light Rail Procurement

To meet the needs of the **service growth** of the Central Subway, **development** along Mission Bay, and growth in service demands and to **prepare for the replacement** of our ageing fleet, the SFMTA initiated the LRV procurement in 2014.

We used a novel structure, placing the 68 expansion vehicles ahead of the 151 replacement vehicles to allow for a single contract and provide a uniform fleet. We now have the **opportunity to apply lessons learned** to this replacement phase.

Key design features

The new trains feature updates from lessons learned on past procurements:

- **Lighter vehicle**—quieter ride for passengers and neighbors
- **Improved interior design:**
 - **Facilitates flow of people**—less blocking the doors
 - **Increased potential standing capacity**—more comfortable ride during peak hours
- **Upgraded passenger information**—know where you are and where you're going
- **Easier to maintain door and step units**—less time spent fixing critical systems

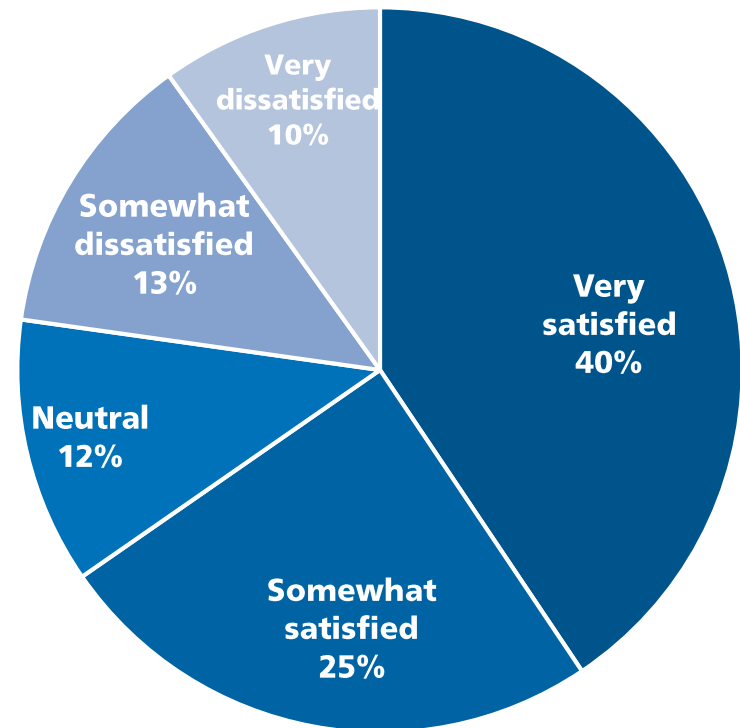
What do riders think of the new fleet overall?

Survey results:
Are you satisfied with the new LRV4s?

Riders are overwhelmingly satisfied with the new vehicles

Majority of those surveyed are regular riders, all had first hand experience onboard the new Siemens trains

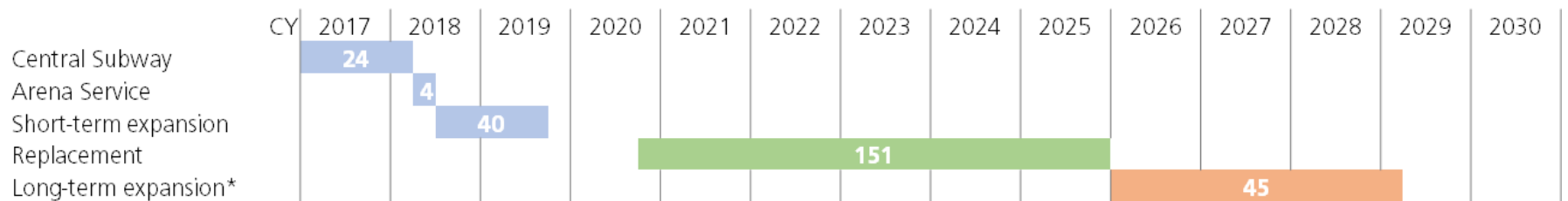
In all categories we surveyed, people are more satisfied than dissatisfied



n=340

Milestones

| | |
|--------------|--|
| Summer 2014 | SFMTA awarded a contract to Siemens |
| January 2017 | First vehicle delivered to SFMTA property |
| Fall 2017 | First vehicle in revenue service |
| Fall 2018 | Operator familiarization complete, systemwide deployment of LRVs |
| Fall 2019 | Complete expansion phase (Phase I) |
| Early 2020 | Target: Initiate replacement phase (Phase II) |
| Late 2025 | Target: Complete procurement of replacement phase (Phase II) |



Status Today

- 66 expansion vehicles delivered, 57 service-ready
- Final expansion LRV to be delivered by September
- Preparing to initiate Phase II: Expansion Phase
- Deliveries continuing on schedule
- Facing challenges related to reliability and availability, but enhancements are underway





PHASE II CONSIDERATIONS

Phase II: Implement lessons learned

Phase II will see vehicle enhancements to improve customer comfort, vehicle maintainability, and enhanced reliability.

Operations: *20 enhancements*

- Improved sunshades for enhanced Operator visibility
- Updated operator panel switches to more easily distinguish functionality (e.g., front door versus all door button)
- Updates to passenger information system to clarify messaging

Maintenance: *22 enhancements*

- Updates to wheel design to make wheel-truing easier
- Modify brakes to better distribute force during quick stops
- Changes to panel securements for easier access

Passenger comfort updates

Based on extensive customer feedback we will be updating:

- Interior seating layout
- Seating type
- Adding additional handholds



Breda End of Life Campaigns

Strategic Capital Investments \$10M

- Replace the most service-disruptive components
- Motor driver boards
- HVAC upgrades
- Coupler work

Rethinking Preventative Maintenance

- Dedicated PM track added to Green Yard
- Step/door campaign added to 20k PM cycle
- Door wiring review added to 20k PM cycle

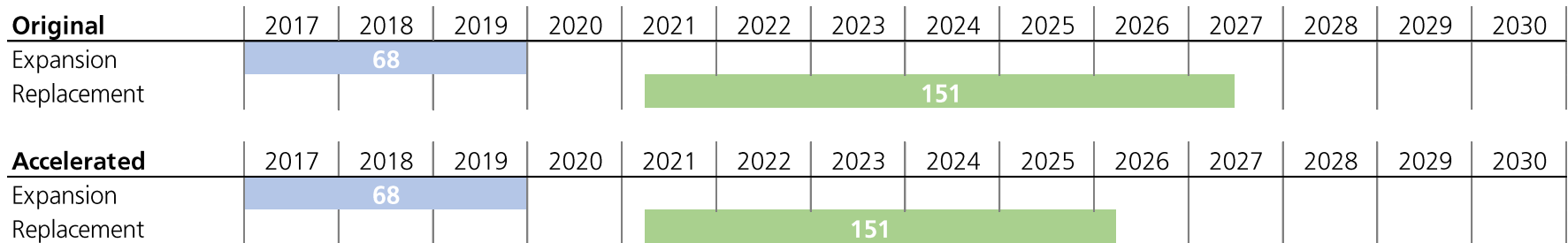
Still face challenges

- Increased mileage by 20% over past five years means vehicles are being asked to do more as they age
- Cost of parts doubled between 2011 and 2015, and they're still climbing
- Parts obsolescence: VOBC isn't manufactured anymore

Early retirement

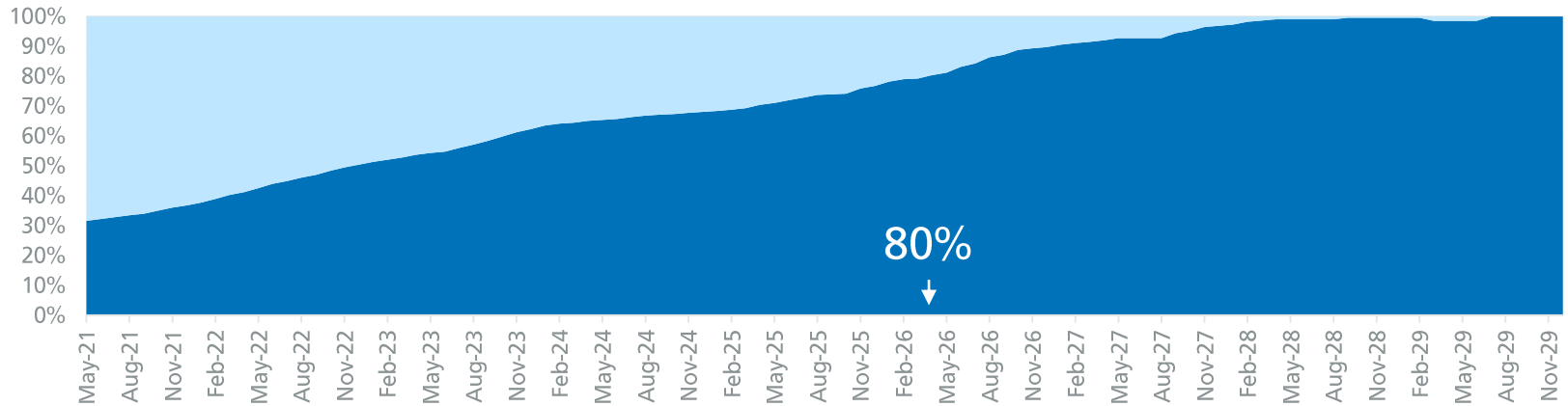
Due to the ongoing LRV procurement, we have the opportunity to accelerate delivery of vehicles to retire the Breda fleet ahead of schedule:

- Accelerate production rate with delivery of final LRV 14-16 months early
- Federal Transit Administration has approved early retirement of the Breda fleet

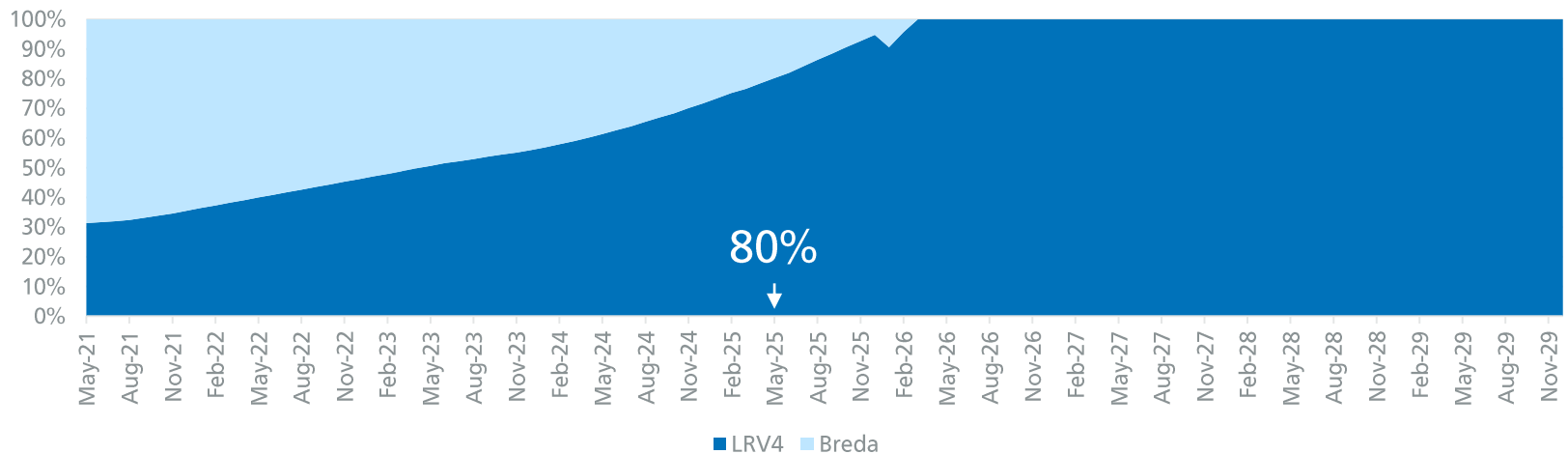


Fleet saturation rate

Original Schedule



Accelerated Retirement



■ LRV4 ■ Breda

Challenges: Incidents

In April 2019, we experienced two serious incidents that required immediate examination. All retrofits were completed by the end of June 2019. Siemens covered costs of retrofits under warranty.

Single panel rear door: An elderly passenger fell into trackway after their hand became caught in vehicle door

- Investigation identified eight similar incidents, three with injuries
- Testing determined door sensitive edge required redesign

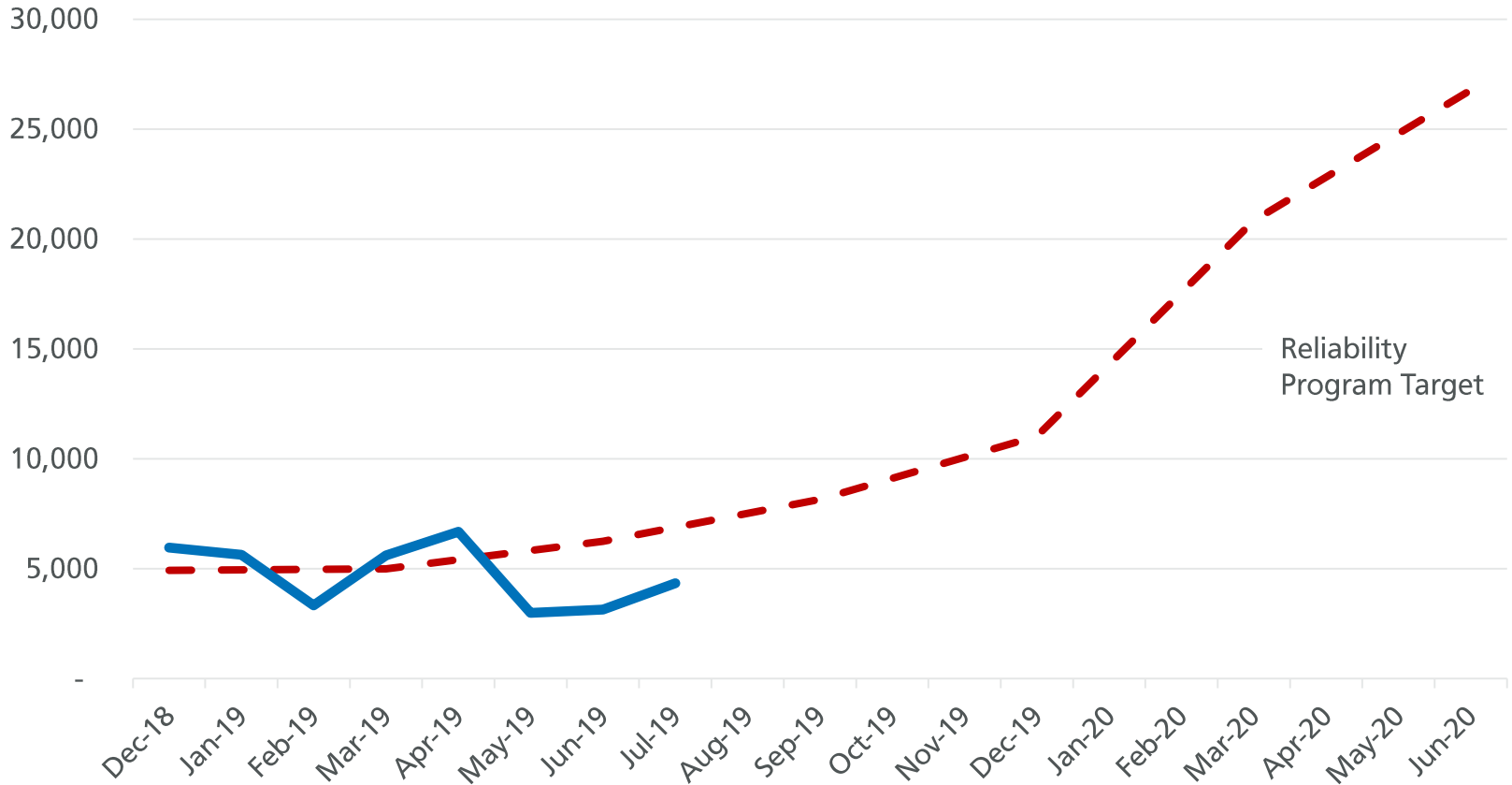
Coupler/shear bolt: An operator reported a coupler failure at the N-Judah Terminal

- Investigation identified broken shear bolts in incident vehicles and damage to 29 couplers
- Root cause was coupler design that required additional clearance between components



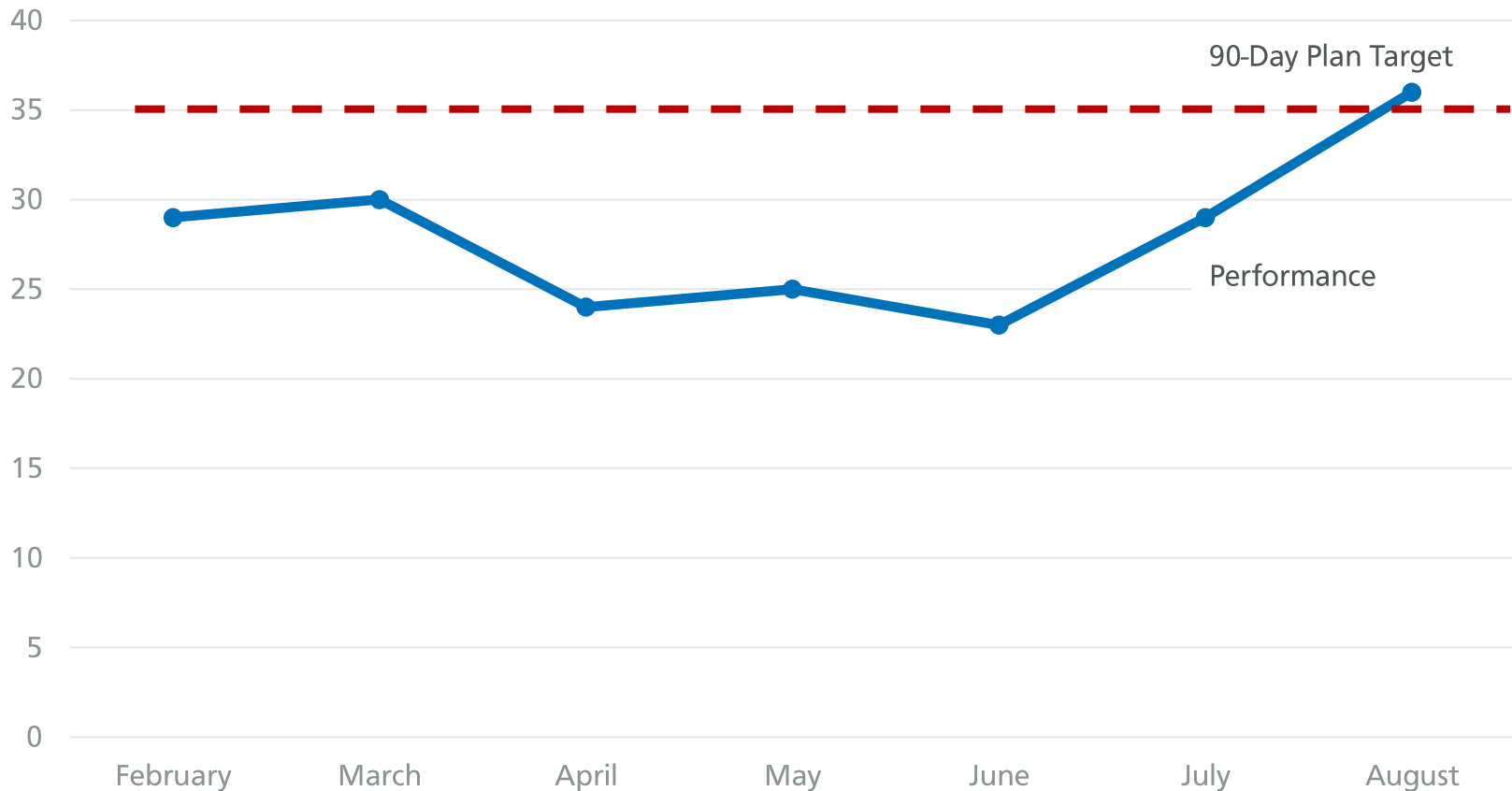
Challenges: Reliability

Mean Distance Between Failures



Challenges: Availability

Vehicles Available for Service by Month



Contributors to Reliability/Availability Challenges

Flat wheels—ongoing, change order required for resolution

The braking system on the Siemens vehicle is designed differently from the Bredas. When operators use the emergency stop, which they do frequently, it causes flat wheels on the Siemens cars. This reduces vehicles available for service and increases the maintenance costs on this fleet.

Water intrusion—resolved, implementation complete

In February, gaskets sealing external cameras from water intrusion began to fail. Because the operators use cameras and not mirrors for safe operation of the vehicle, we had a major reduction in availability and an increase of vehicles removed from service.

HPU—resolved, implementation to be completed by Oct 2019

Three components within the Hydraulic Power Unit (HPU) have not functioned reliably, resulting in vehicles with locked brakes. This has caused a spike in service-related disruptions and represents approximately 1/3 of the maintenance failures driving low reliability.

Executing Phase II

We are working towards a series of change orders to:

1. Ensure reliability improvements are executed on existing fleet
2. Incorporate public feedback and maintenance enhancements into replacement fleet
3. Continue to pursue early retirement of ageing Breda fleet

Next Steps

We will continue to ensure the future fleet meets the high demands of our riders through:

- Active monitoring vehicle performance and making improvements as required
- Monthly reporting to the public on progress and challenges
- Executing important updates to the vehicle's engineering and design
- Incorporating public feedback through on-board enhancements



THANK YOU