BENCHMARKING GROUP OF
NORTH AMERICAN LIGHT RAIL SYSTEMS

The State of Light Rail Transit in America

2018 APTA Rail Conference Presentation

June 2018

Imperial College
London

Presentation Agenda

- **Who are we :**
  - **Imperial College/Railway & Transport Strategy Centre**
  - **GOAL, the Benchmarking Group of North American Light Rail Systems**
- **An Overview of the Characteristics of Light Rail in North America**
- **Impacts of Characteristics on Operational Performance**

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Introduction to the Railway and Transport Strategy Centre

International Benchmarking: Eight Public Transit Groups – Benefits Drive Continued Participation

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Railway and Transport Strategy Centre

Community of Metros CoMET	Nova Group of metros	IBBG	ISBERG
Founded 1994	Founded 1998	Founded 2004	Founded 2010
18 Members, including New York, London, and Hong Kong	20 Members, including Rio, Toronto, and Barcelona	15 Members, including Dublin, Montreal, Paris, and Singapore	14 Members, including Munich, Tokyo, and Sydney

ABBG	GOAL	International Mainline Rail	Railway Infrastructure
Founded 2011	Founded 2016	Founded 2016	Founded 2016
22 Members, including Austin, Cleveland, and Rhode Island	11 Members	6 Members, with Norway, Belgium, Netherlands, and Australia	4 members, initially in Australia

Benchmarking is the Search for Best Practices That Lead to Superior Performance

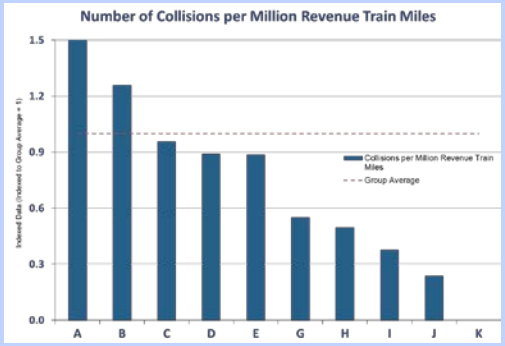
Benchmarking Is:

A systematic process of *continuously* measuring, comparing and *understanding* performance and *changes* in performance

Of a diversity of key business processes

Against comparable peers

To help the participants improve their performance



(Adapted from the definition by Lema and Price)

Benchmarking Provides:

- **Perspective through Data:**
  - How do we **compare** to our peers?
  - What are our **strengths**?
  - What are our **weaknesses**?
  - Quantitative Backing for "rules of thumb"
- **Best Practices through Discussion:**
  - What are others doing to **improve**?
  - What **works**/what doesn't?
  - How to **implement best practices**.

"Rarely is there a challenge that someone else hasn't faced…"

GOAL Key Performance Indicator System

Growth & Learning

G1 **Passenger Boardings, Car Miles & Hours** *(5-yr % change)*
G2 **Passengers per Revenue Mile & Hour** *(car & train)*
G3 **Staff Training** *(by staff category)*

Customer

C1 **On-Time Performance** *(% of departures, 0 <> +5 min)*
C2 **Headway Regularity (to come)**
C3 **Delay Minutes** *(passenger & train)*
C4 **Passenger Miles per Revenue Capacity Mile** *(seat & planning)*
C5 **Capacity Miles per Route Mile**
C6 **Percent of Trips Operated**

Internal Processes

P1 **Peak Fleet Availability & Utilization** *(not used by cause)*
P2 **Staff Productivity** *(train or car miles or hours / labor hr)*
P3 **Staff Absenteeism Rate** *(by staff category)*
P4 **Mean Distance Between Technical Failures**
P5 **Mean Distance Between Incidents** *(>5 min delay)*
P6 **Lost Vehicle Miles** *(internal & external causes)*
P7 **Percent On-Time Pull-outs** *(% of departures, later than 4:59)*

Financial

F1 **Total Operating Cost per Total Mile & Hour** *(car/train)*
(F2 service operation, F3 maintenance, F4 admin)
F5 **Total Operating Cost per Passenger Boarding & Mile**
F6 **Operating Cost Recovery** *(fare & other commercial revenue per operating cost)*
F7 **Revenue per Passenger Boarding & Mile** *(categories)*
F8 **Investment Rate** *(5yr rolling avg per operating cost)*

Safety & Security

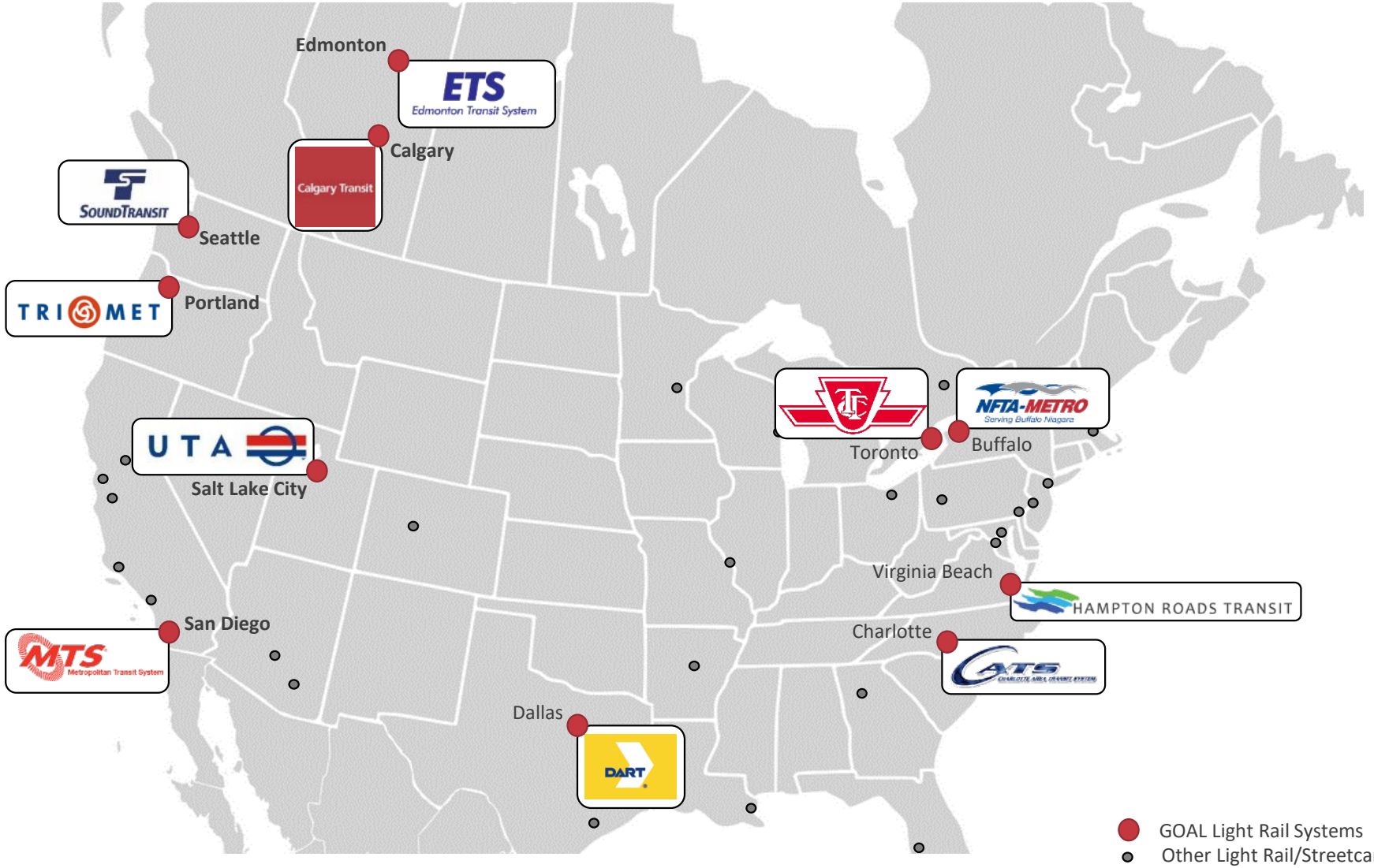
S1 **Train Collisions per Train Mile & Hour** *(preventable, non-preventable)*
S2 **Staff Injuries per Staff Work Hours**
S3 **Staff Lost Time from Accidents per Staff Work Hours**
S4 **Passenger Injuries per Boarding & Pax Mile**
S5 **Incidences of Crime per Boarding** *(including station & on-board)*
S6 **Signal Violations**
S7 **Derailments** *(non revenue, revenue)*

Environmental

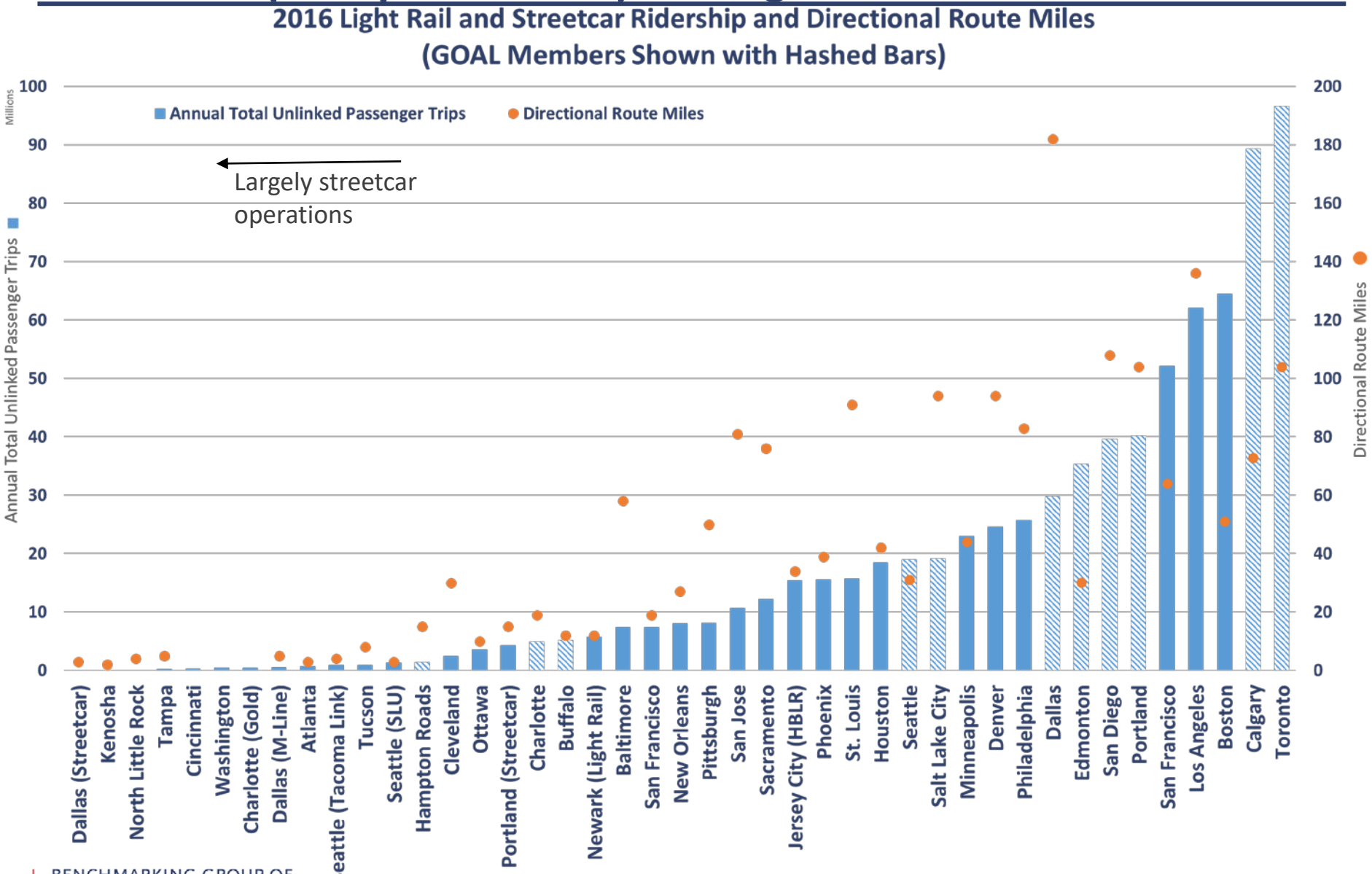
E1 **Energy Consumption (Traction and Non-Traction)** *(per total car mile, pax mile, and capacity mile)*
E2 **CO2 Emissions per Total Car Mile & Pax Mile**

Introduction to GOAL

GOAL: 11 Member Light Rail Systems Across North America – A Diverse Mixture of System Ages and Characteristics



GOAL Covers Wide-Range of Light Rail Systems, from Smallest (Hampton Roads) to Largest Toronto



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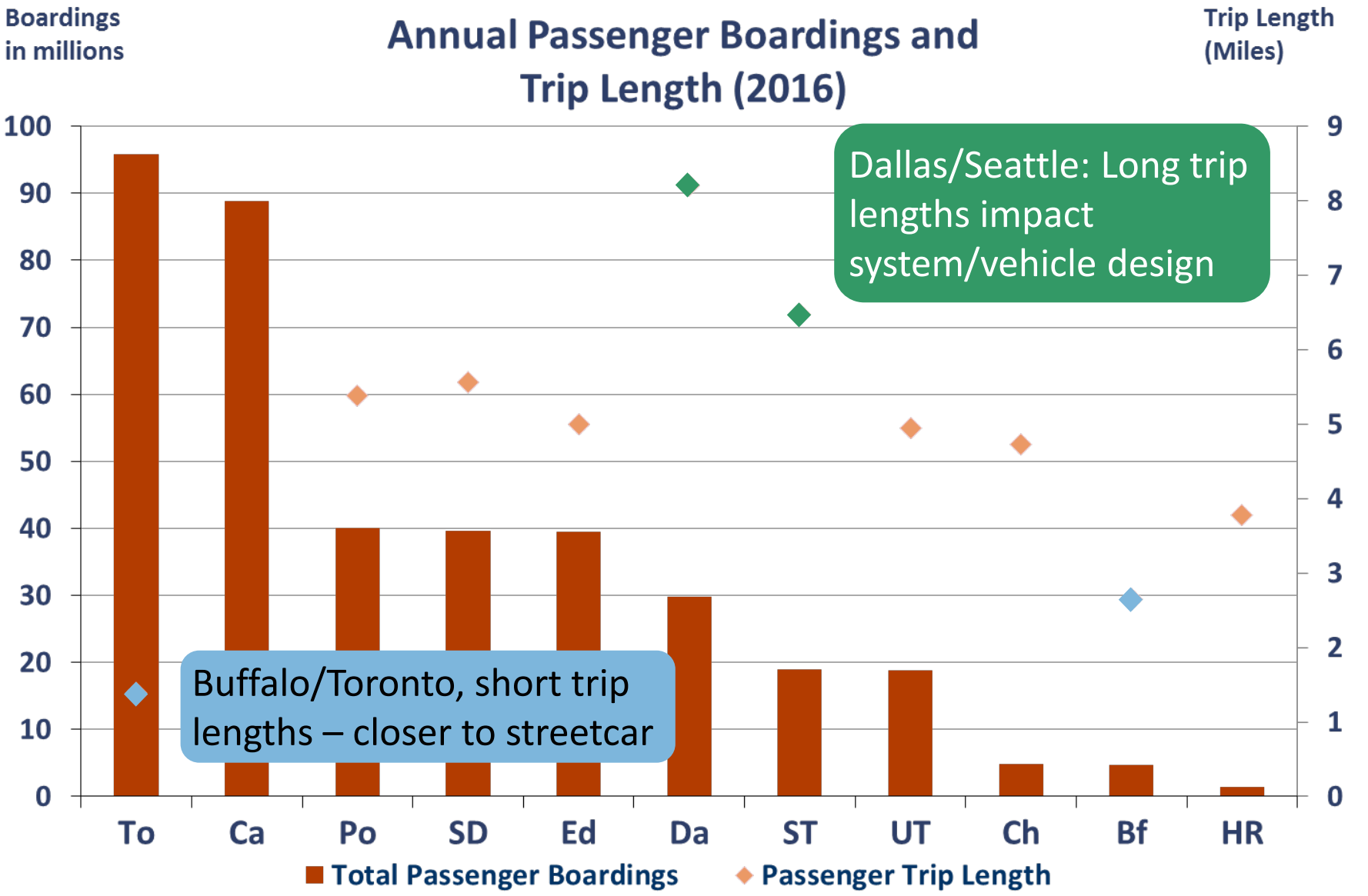
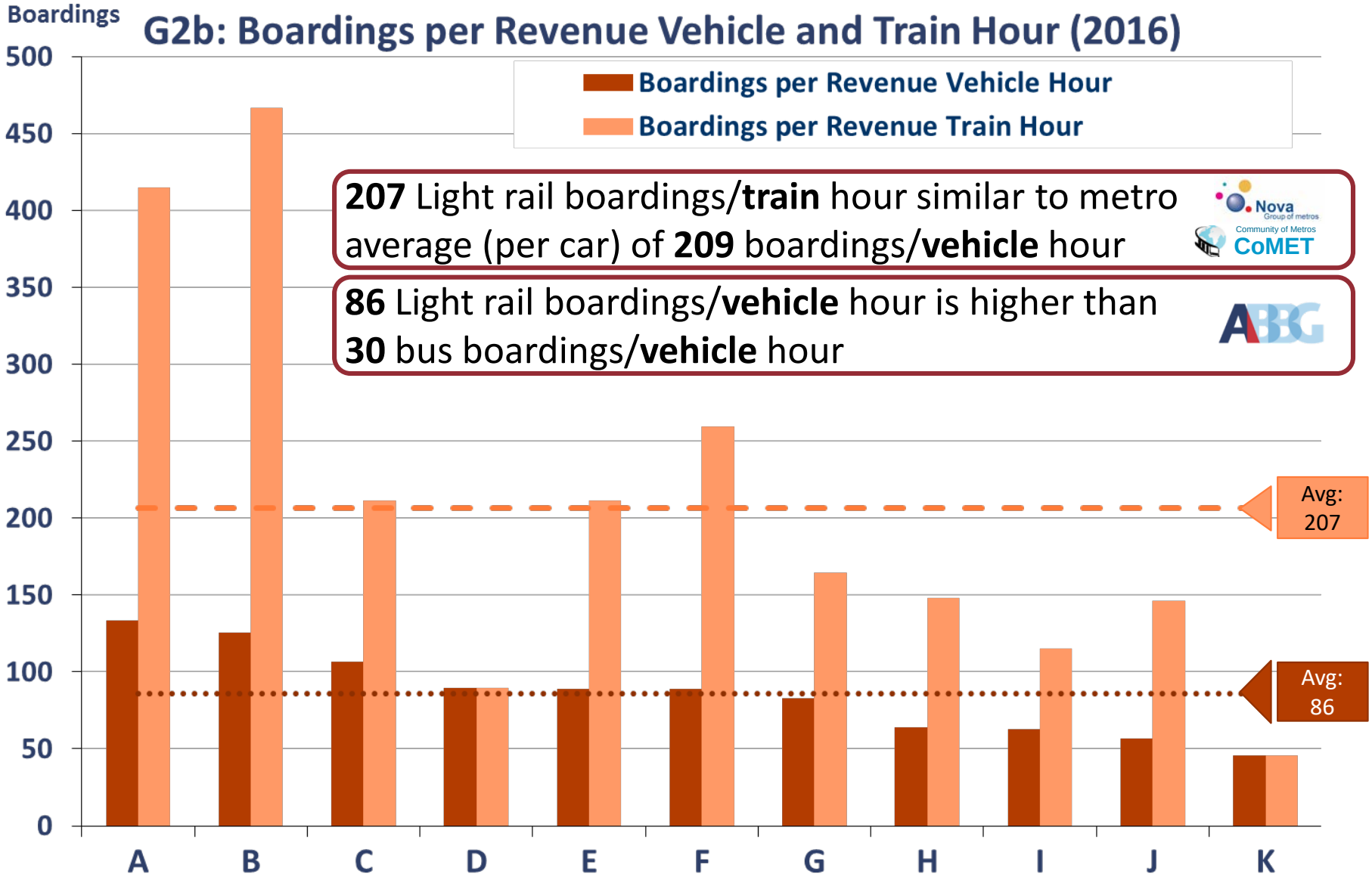
Benchmarking Methodology – Normalization Options Adjust for Different Contexts, Including 'Extreme' Data Differences

	Min	Max				
Vehicle Weight	**40 Tons**	**70 Tons**	Total Ton Miles	Total Vehicle Capacity Miles		
Layover & Deadhead Percentage	**11 percent**	**33 percent**	Revenue Vehicle Capacity Miles		Total Vehicle Hours	Revenue Vehicle Hours
Vehicle Planning Capacity	**104 People**	**181 People**		Revenue Vehicle Miles		
Average Commercial Speed	**7.6 MPH**	**22 MPH**	Revenue Vehicle Hours			
Passenger Trip Length	**1.5 Miles**	**8 Miles**	Passenger Boardings	Passenger Miles		
Train Length	**1 vehicle / 50 Feet**	**5 vehicles / 400 Feet**	Vehicle Miles	Train Miles	Train Hours	Vehicle Hours

Context - Ridership: Wide Range, but Normalization Allows for Direct Comparison of Different Sized Agencies



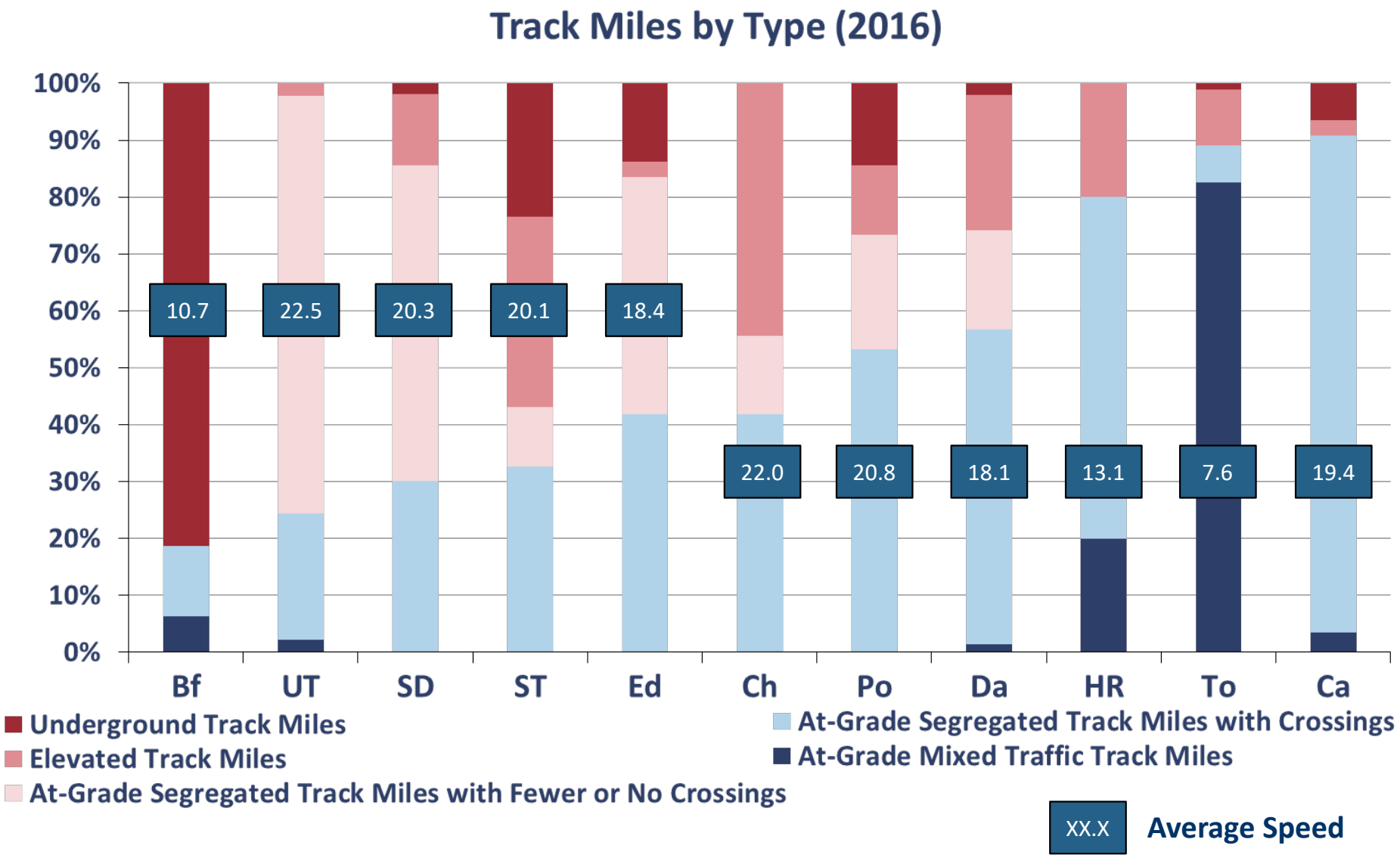
Example KPI – Boardings per Vehicle / Train Hour: Range of Density, with Typical Light Rail Train Equal to a Metro Car



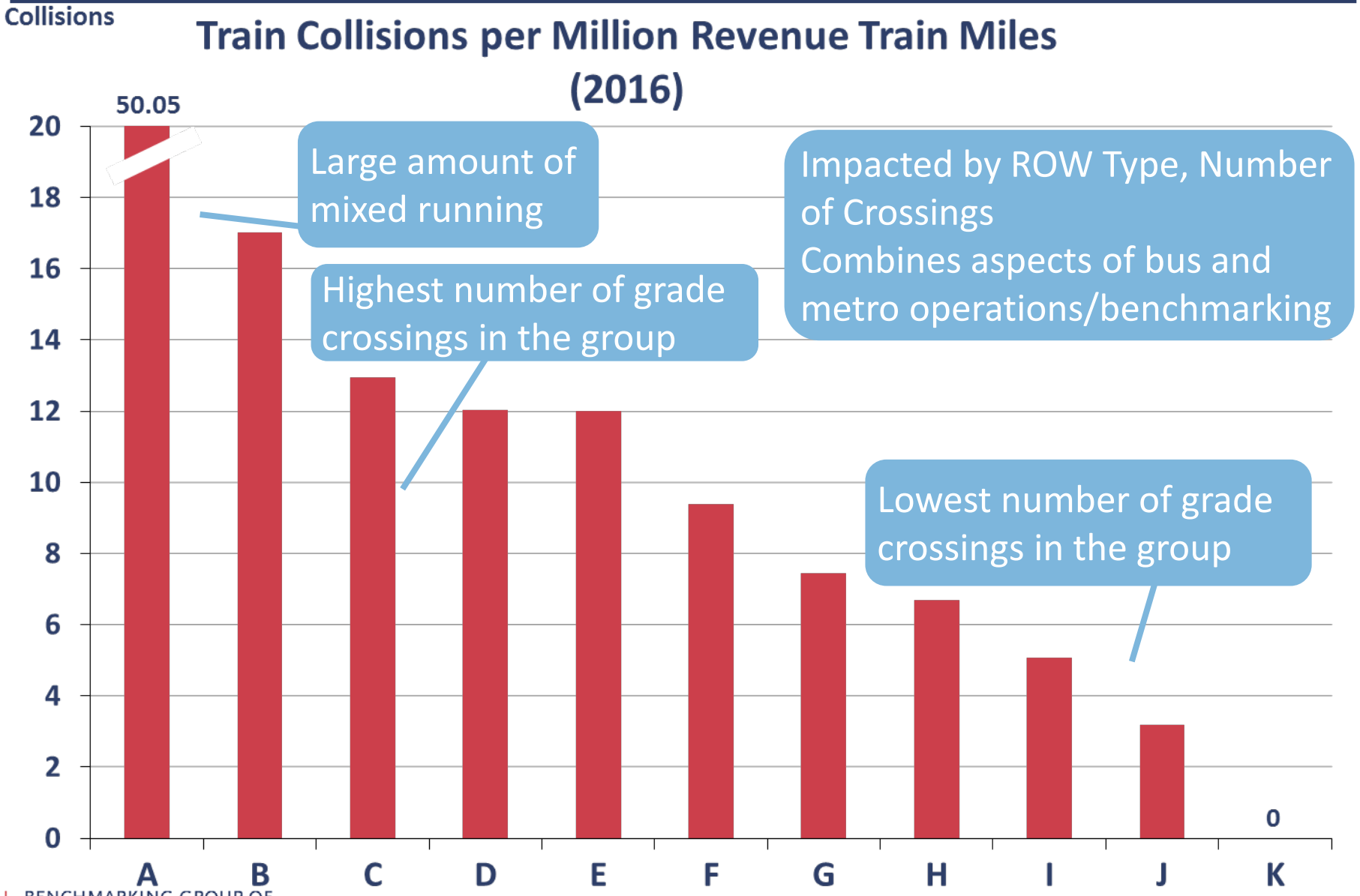
207 Light rail boardings/**train** hour similar to metro average (per car) of **209** boardings/**vehicle** hour

86 Light rail boardings/**vehicle** hour is higher than **30** bus boardings/**vehicle** hour

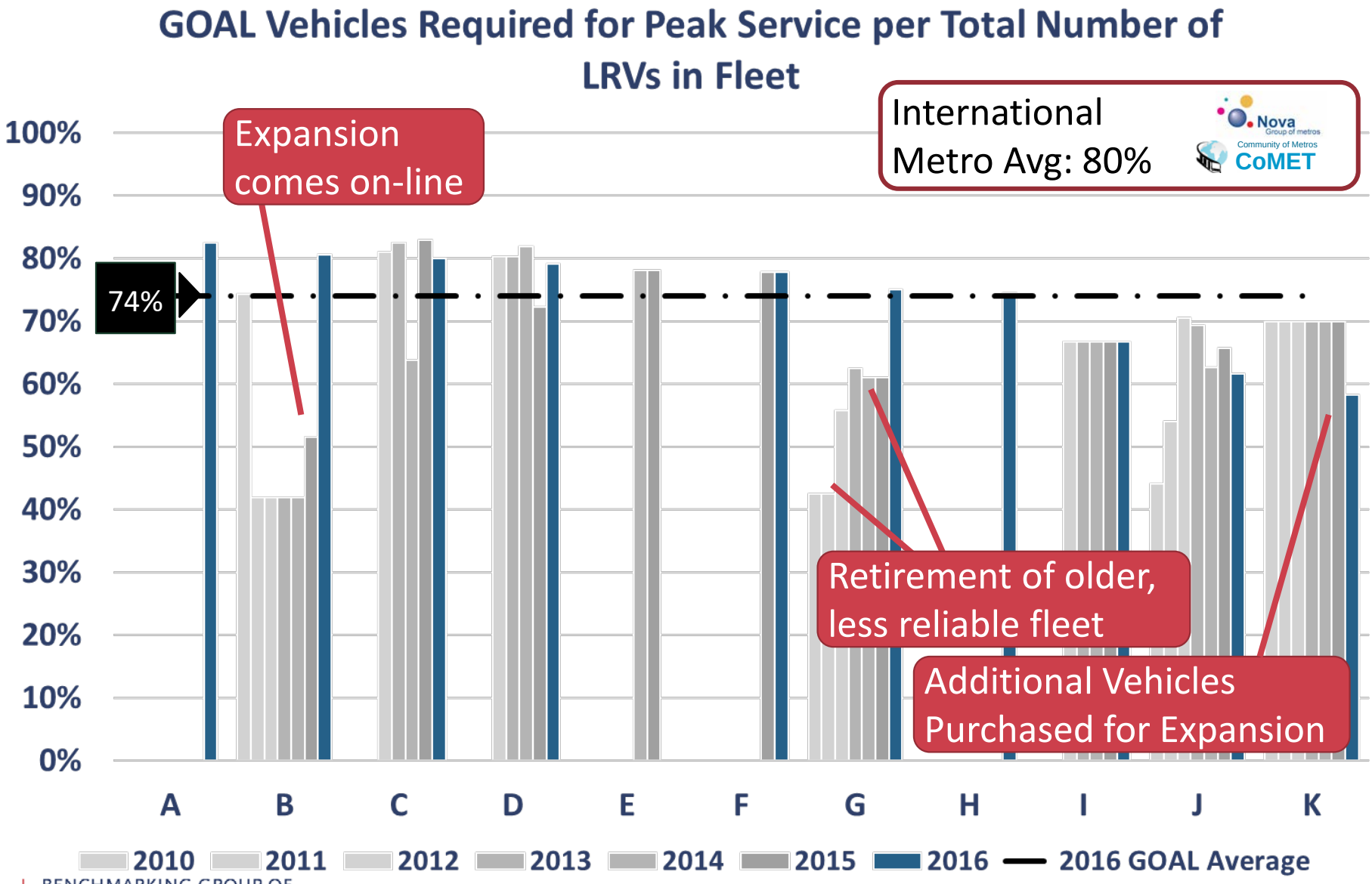
Context: Network by Type – Broad Comparability Across the Group with Primarily At-Grade Segregated Running



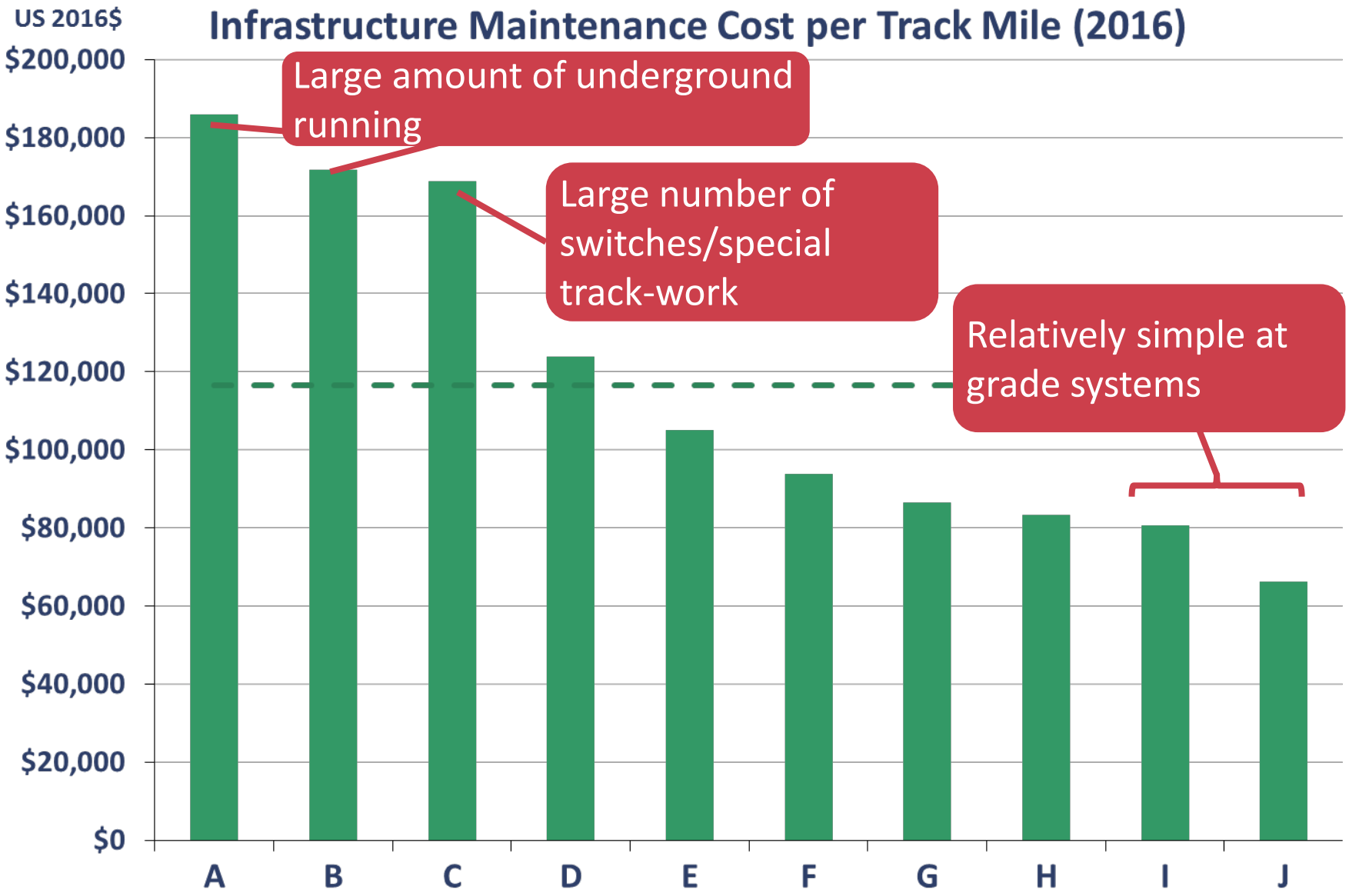
KPI Example: Collisions per Revenue Train Miles – Impacts Safety, Vehicle Availability, Cost



KPI Example: Fleet Required for Peak Service – Reflects Service Levels, Fleet Availability, Age

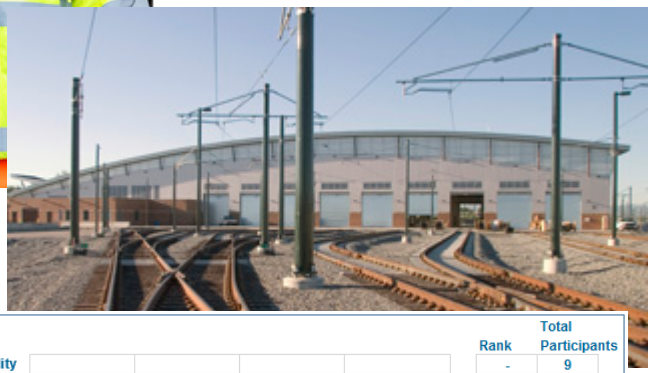


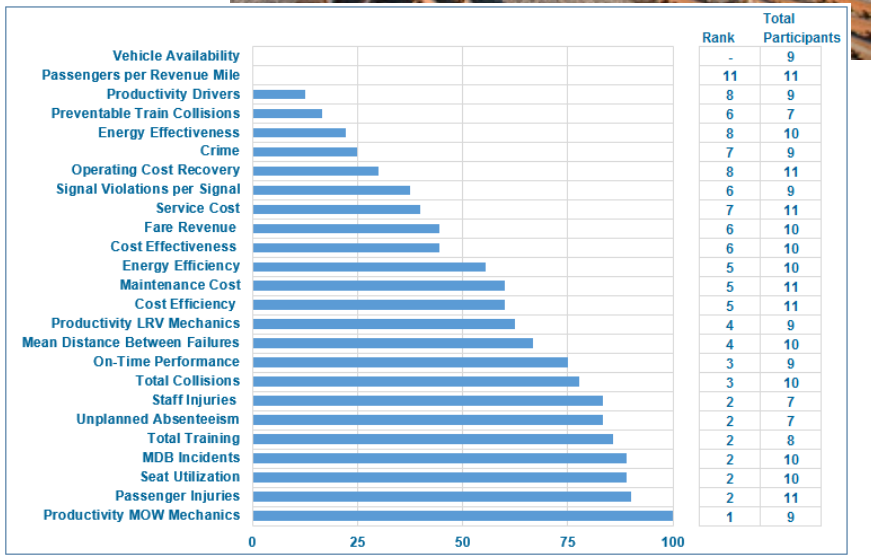
KPI Example: Influence of Infrastructure Complexity on Maintenance Costs



Examples of Benefits Identified Through Benchmarking

- **Member 1: Adjust supervision levels for LRV Operators**
  - Used a small study that looked into supervision levels and practices across the group
- **Member 2: Increase funding/staffing for LRV maintenance**
  - Use KPI data to understand how much comparable members spend on maintenance per vehicle, how many LRV mechanics per vehicle as well as mean-distance between failures
- **Member 3: Identify areas for operational focus**
  - Use dashboards to understand relative performance among members on KPIs and areas of improvement





Thank You! Any Questions?

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