Community of Metros
CoMET

Nova
Group of metros

World Class Metro Systems: What Can Be Learned From the Global Metro Community

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The DNA of World Class Metro Systems: Seven Key Attributes Observed at Global Metros

- Sustainable Fares and Secure Funding
- Well-Managed Safe and Secure Environment
- Holistic and Mature Approach to Asset Management
- Customer-Oriented Focus on Service Quality
- High Levels of Frequency and Capacity
- Flexible and Learning Organization with a Continuous Improvement Culture
- Politically Unified Governance Working Toward Shared Objectives

Introduction

The Railway and Transport Strategy Centre (RTSC) Manages 7 Benchmarking Groups of Transit Operators

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- **Established in 1992 by British Rail, RTSC is a world leader in public transit benchmarking**
- **Key research themes:**
  - Benchmarking/performance measurement
  - Urban and regional transit operations
  - Transportation economics and policy
  - Statistical modelling and analysis
- **2015 rankings show Imperial College London as 8th in the world (Times, QS)**
  - Often considered the "MIT of Europe"
- **International team of 20 with a wide variety of experience and expertise**

RANK	UNIVERSITY	LOCATION
Overall Score	Search for universities...	
1 100.0	Massachusetts Institute of Technology (MIT)	
2 98.7	Harvard University	
3 98.6	University of Cambridge	
3 98.6	Stanford University	
5 97.9	California Institute of Technology (Caltech)	
6 97.7	University of Oxford	
7 97.2	UCL (University College London)	
8 96.1	Imperial College London	
9 95.5	ETH Zurich - Swiss Federal Institute of Technology	
10 94.6	University of Chicago	

History and Experience of Benchmarking at Imperial College – 20+ years of successful worldwide benchmarking projects

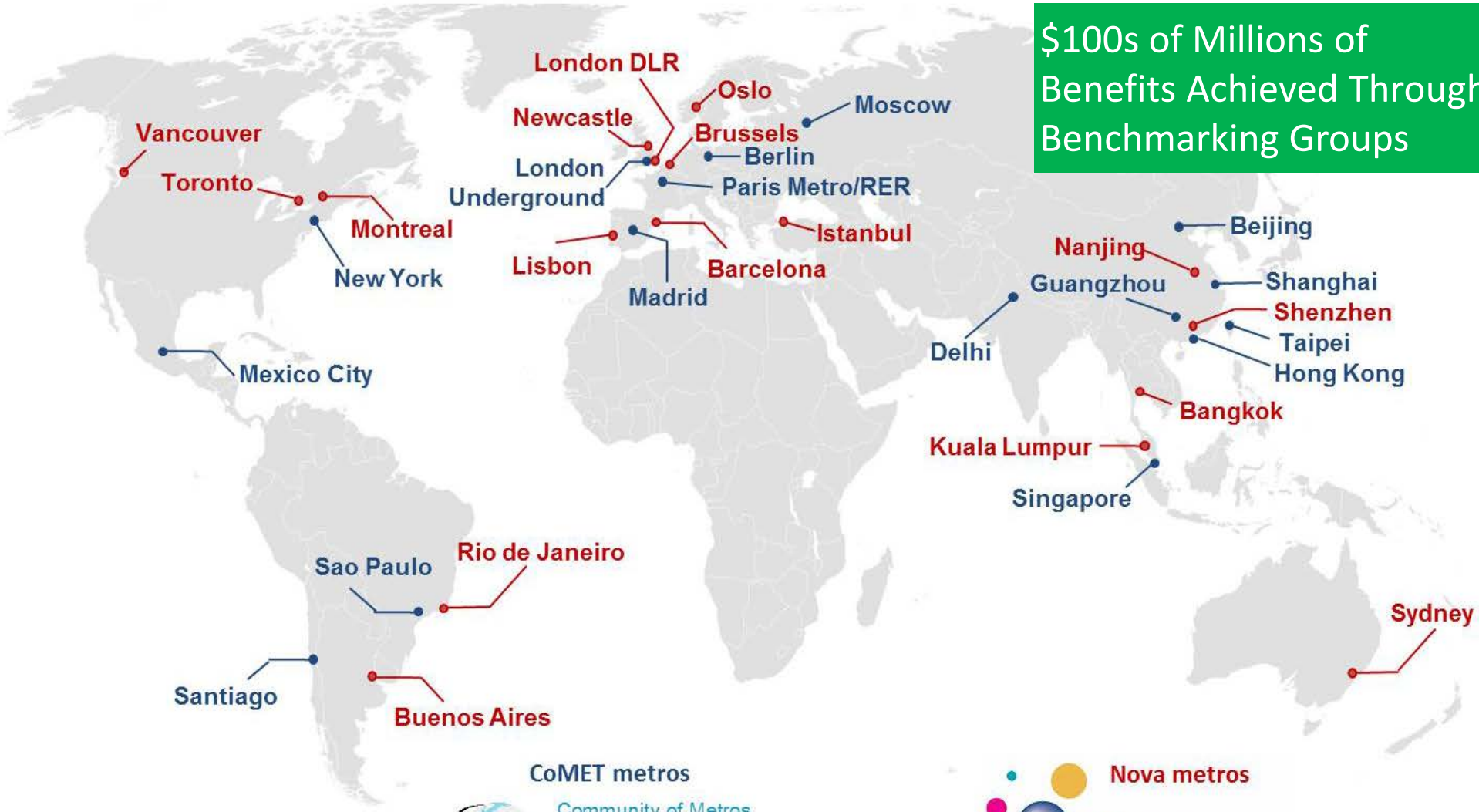
Community of Metros CoMET	Nova Group of metros	IBBG	ISBERG	ABBG
Founded 1994	*Founded 1998*	*Founded 2004*	*Founded 2010*	*Founded 2011*
17 Members, including Beijing, Paris, Hong Kong, Delhi, and Moscow	16 Members, including Bangkok, Brussels, Barcelona, and Montreal	15 Members, including Dublin, Lisbon, Seattle, Vancouver, and Montreal	14 Members, including LIRR, Metro-North, BART, Munich, Cape Town, and Tokyo	20 Members, including Rochester, Cleveland, Austin, and Hampton Roads

Significant benefits have driven continued participation – for example, New York and London have both been CoMET members for 22 years and IBBG members for 12 years

GOAL

New Group for North American Light Rail Systems (GOAL) established in 2016 with 10 initial members: Seattle, Portland, San Diego, Dallas, Salt Lake City, Edmonton, Toronto, Buffalo, Hampton Roads, and Charlotte

CoMET and Nova: The World's Metro Benchmarking Community – 34 Urban Rail Systems in 32 World Cities



$100s of Millions of Benefits Achieved Through Benchmarking Groups

Metro Systems Are Complex, Expensive, and Essential for the Cities They Serve

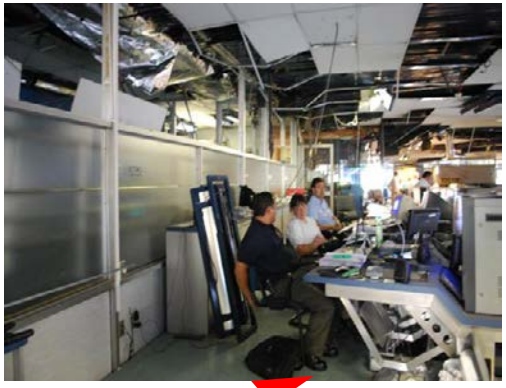
- Metro are long-term continuous investments – so it is critical to **make the most of very expensive infrastructure**
- Requires a lot of money for **sometimes invisible infrastructure** – perhaps even more essential than initial construction to leverage past investment
- To be **world class**, we have to look at global peers

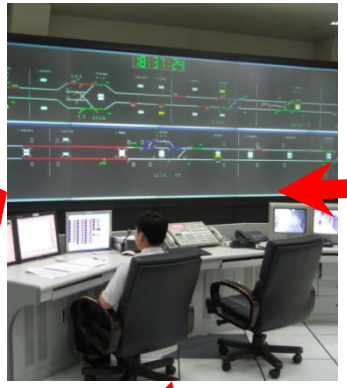
Why German trains don't run on time any more

For all the old cliches about Teutonic efficiency, much of Germany's transport infrastructure is in a terrible state of disrepair, and many major works have been badly botched. A chronic lack of investment is to blame

The good news is that you aren't alone! Challenges (and solutions) are shared globally

Metro Systems Are Uniquely Complex and Difficult to Manage – A Mixture of Technical, Commercial, and Political Complexity

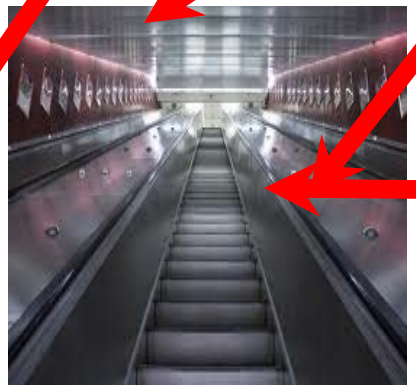


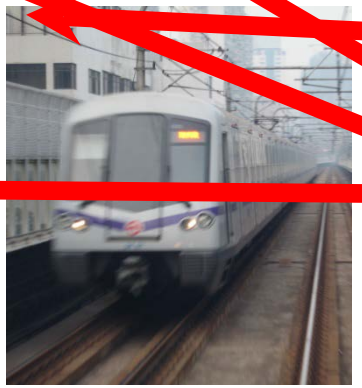


Politics, External Events, Funding

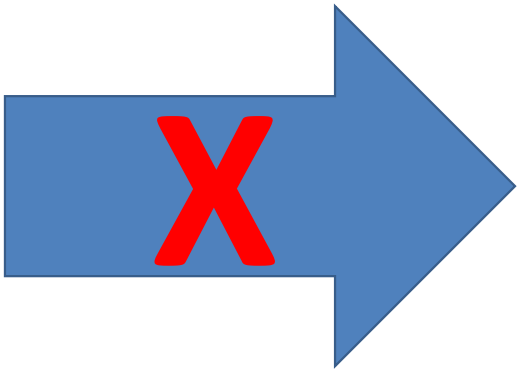
Assets and Interfaces

Service Delivery with Large Volumes of Workers and Customers





Sustainable Fares and Secure Funding



What Does It Cost to Sustain A Metro System in the Long Run? How Can That Be Worth It?

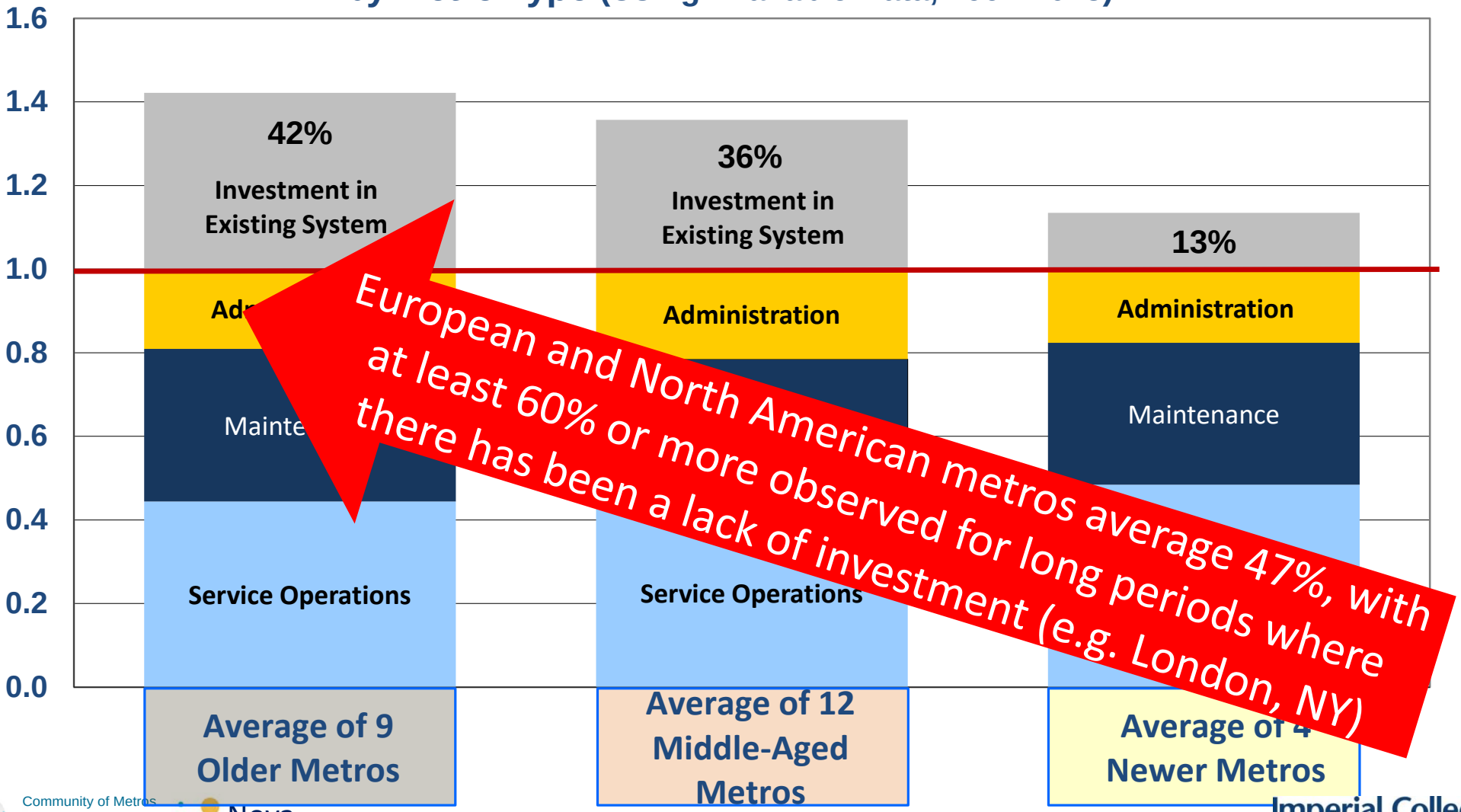
- The need for reinvestment to reinvest to renew metro infrastructure will always exist
- Improvements and enhancements are more than worth the costs
  - **State of good repair ("it works") is not enough** to deliver a high-quality metro fit for the future
  - Costs must be considered in the context of wider benefits (e.g. to the economy and environment)
- To counteract rising costs, metros:
  - Seek **continuous improvements in productivity and efficiency** for labor and energy
  - Substitute technology for labor (e.g. **automation**)
  - Ensure that **fares are regularly increased** to match rising costs (i.e. inflation)

"We believe that we will have to spend 3x the current asset value over the next 50 years to maintain the infrastructure at the same level of performance"
Leader of Middle-Aged Metro System

"Every £1 spent renewing and modernising Metro is worth up to £8 to the economy compared to the cost of letting the system decline and fail"
Tyne and Wear Metro in Newcastle, UK

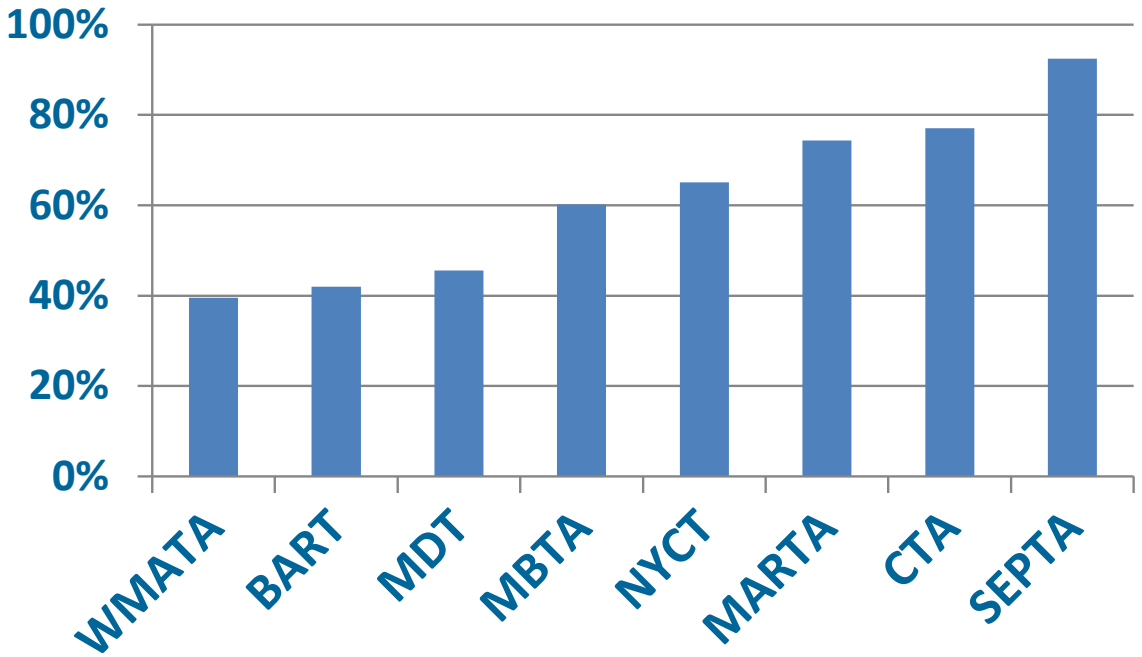
Using Available Data Over the Past 20 Years, the Average Annual Reinvestment Rate (as % of Operating Costs) Worldwide is 34%

Average Expenditure and Reinvestment as a Proportion of Opex by Metro Type (Using Available Data, 1994-2013)



Among Eight Older US Systems, WMATA Had the Lowest Reinvestment Rate in the 2003-2014 Period

Average Capital Spending on Existing System as % of Annual Operating Cost (2003-2014, Source: FTA NTD data)



The need to "catch up" is driving reinvestment in US systems, demonstrating the dangers of falling behind from not reinvesting continuously

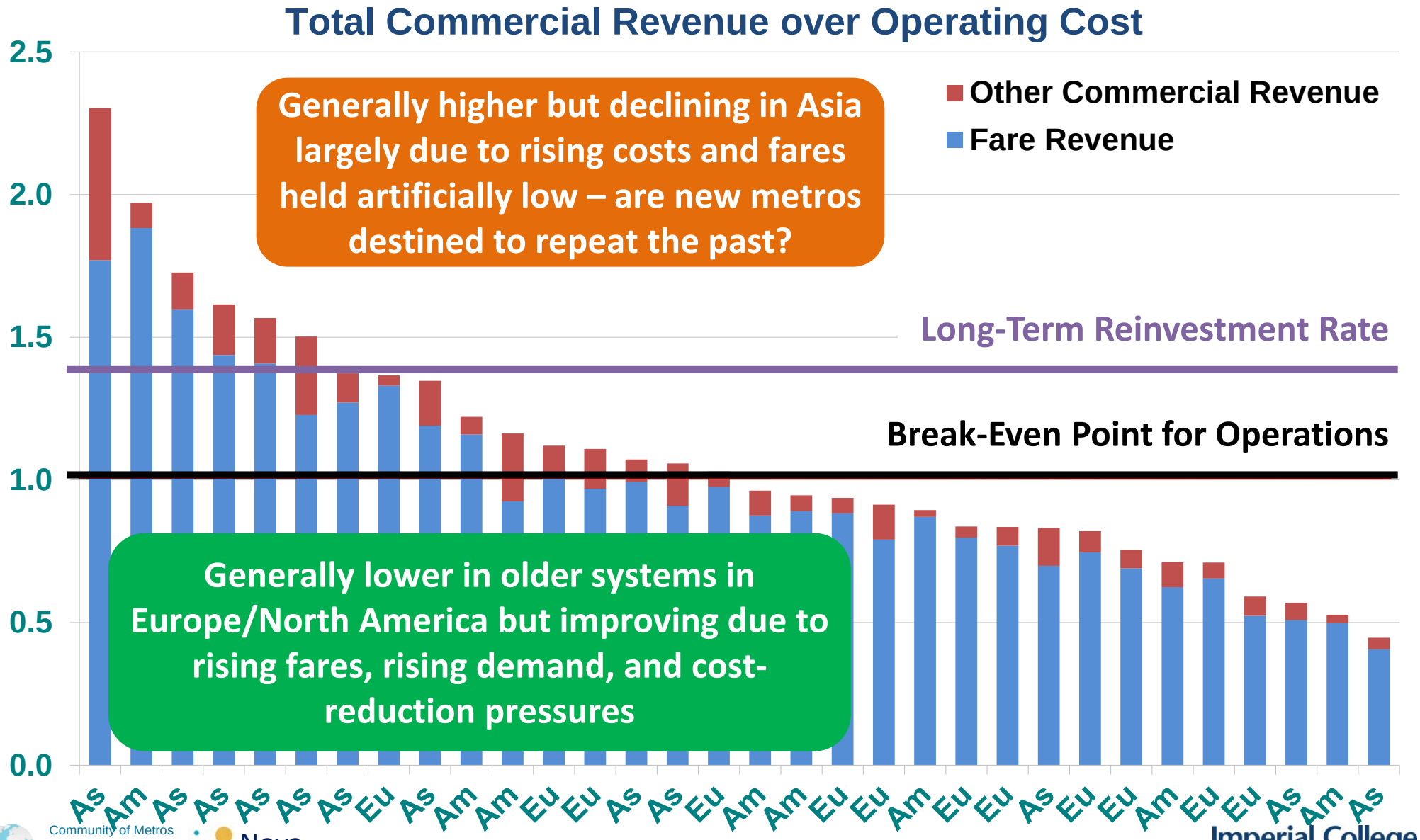
Funding Certainty has Fundamental Impacts on Metros, Especially for Planning Renewals

Metros have estimated that savings of at least 15% are possible through "economies of planning" when funding is predictable and secure

Annualised / Unpredictable Funding	Medium Term Predictability (up to ~4-5 years)	Longer Term Funding Predictability (5-10 years)	Self Sufficient or Long-Term Contract (10 years +)
Long term planning difficult Unplanned failures Greater reliance on maintenance	Major commitments difficult or require additional funding May need to re-prioritise or defer	Generally able to commit to major programs	CAN control plans / predict for life cycle Less 'peaky' spending with balanced programs

Am	Eu	As	Eu	As	Eu	Eu			As
Am	Am	Am	Am	Am	Eu	Eu			Am
As		As	Am						

Cost Recovery: Typical for Metros in Europe and North America to Require Subsidy Due to Lower Density and Higher Costs



A Metro's Funding Regime and Fares Policy Will Dictate Its Long-Term Economic Sustainability and Quality

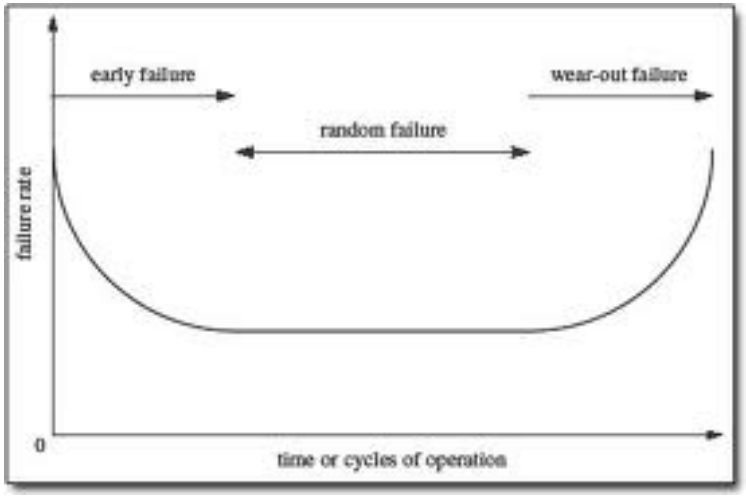
- Strong fare revenue at WMATA due to distance-based fares, regular increases, and longer-distance commuters – it is **essential that this good practice WMATA fares policy continues**
- World best practice: **change fares every year**
  - Keeping fares the same is really a reduction! Fares need to rise with inflation to maintain position or even above inflation to meet rising customer expectations
- Non-fare revenues are valuable but limited – on average 10% of metro costs
  - 15% a realistic maximum – WMATA appears to be about 9%
  - Good practice to continuous seek and **exploit new opportunities for non-fare revenues**

Well-Managed Safe and Secure Environment

Metro Systems Mix Large Numbers of Passengers, Workers, and Dangerous Moving Parts: Safety and Security Are Prerequisites

Safe from accidents	Impacts minimised (ALARP) Dynamic publicity campaigns Use of platform doors
Safe from other people	Terrorism, violence, theft, vandalism: Multi-agency deployment led by intelligence and technology
Quantitative, scientific risk management	Proactive approach using ERM Measure and monitor trends: precursors/top events, near misses
Positive Safety Culture	Collaborate with all stakeholders "No blame" balanced with accountability ("just culture")

Holistic and Mature Approach to Asset Management



Increasing use worldwide of technology and automation to improve performance and reduce costs ('smart' and 'eco' everything: ATO, lighting, air-con, elevators/escalators)

Key Challenge:
Planning for and Investing in Things That Aren't Sexy

Ensure systems, processes and strategies are in place ahead of time to prepare for asset aging

- Need to know the assets – management of asset information essential in developing a strategy
- Analysis of detailed data can then enable planning from a whole-life / life-cycle cost point of view

Asset management essential for improving reliability

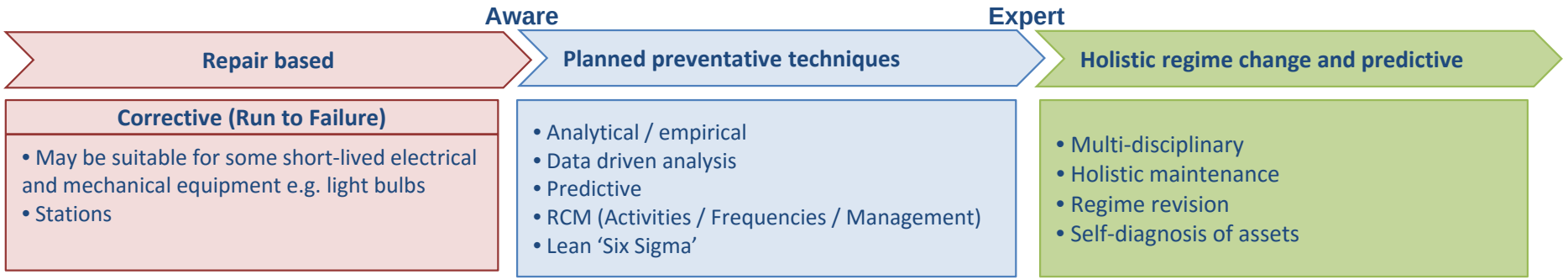
- Good asset management is arguably impossible without secure long-term funding

Increasingly better understanding of the whole-life costs and benefits of rail transit (in some places)

Emerging Practice Worldwide is Moving to More Holistic and Mature Approaches to Maintenance and Renewals in Context

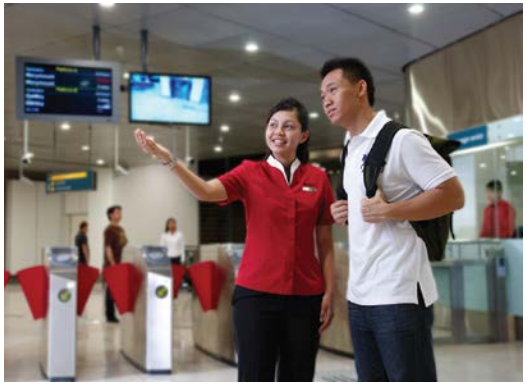
Least mature → **Most mature**

Engineering Based	More Detailed Analysis	Strategic / Business Analysis
When can I replace it?	**How long can I make it last?**	**How can I optimise whole life cost?**
• Assets **scheduled for renewal** based on end of nominal life • **Renewal work triggered by non compliance to standards** • Generally **one prescribed response** to non compliances	• **Strategy focused on requirements and objectives** • **Condition based** using analysis rather than simple residual life • Different intervention **options considered**	• **Whole-life based asset strategies** reflecting needs and considered in context • **Established rules continuously reviewed and improved** • **Life extension** rather than residual life based approach



Customer-Oriented Focus on Service Quality



Moving Trains and Hauling Passengers vs. Transporting People and Serving Customers


Technical Organizations Focused on Operational Goals


Service-Oriented and Customer-Focused Organizations

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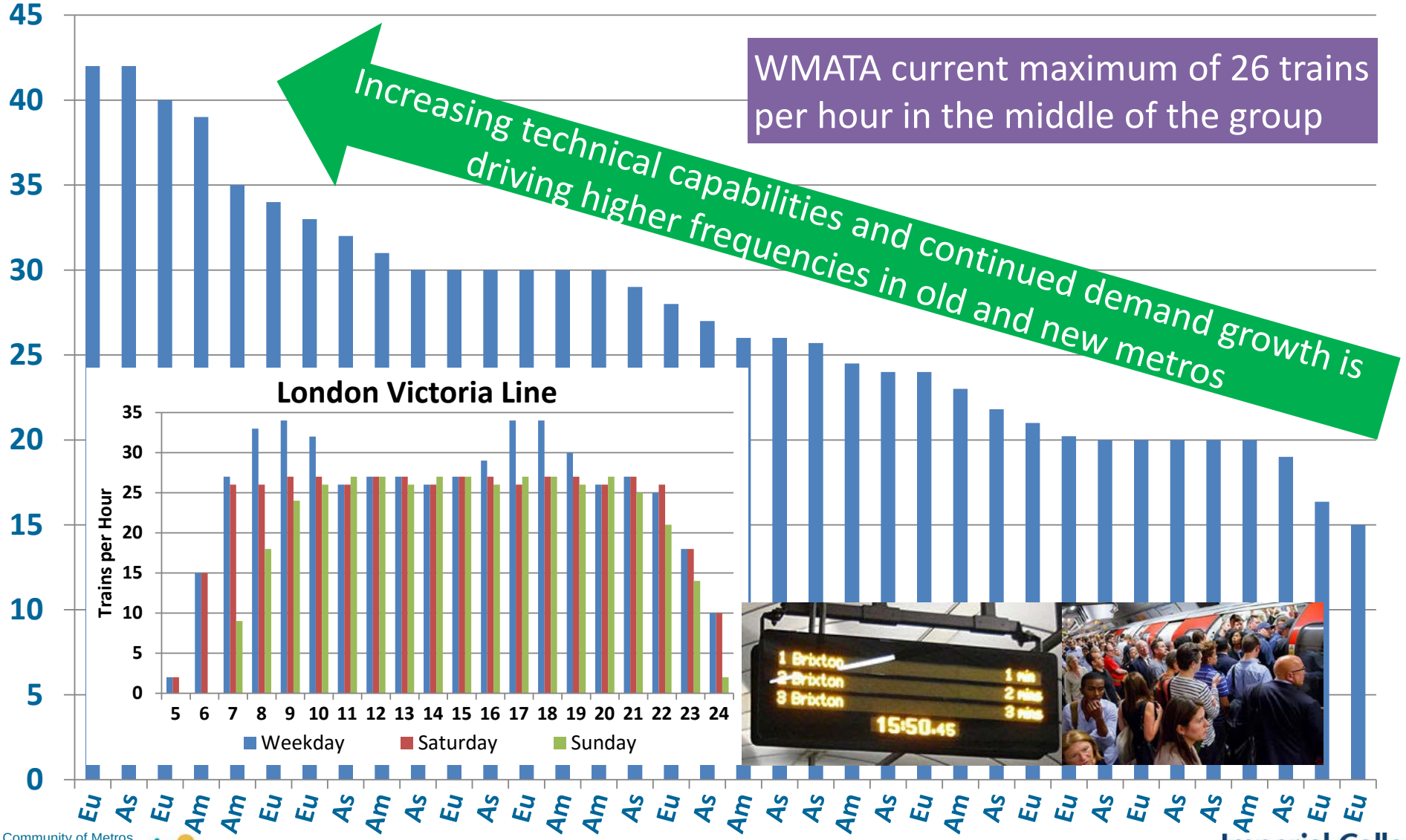
Customer Focus: Doing Simple Things Well and Taking Advantage of New Technology to Meet Rising Expectations

- **Restoring Trust and Confidence**
  - **Clean, bright, good way-finding** – making a visible difference doesn't have to cost a lot
- **New Technologies**
  - Contactless cards, new fare options
  - Provision of wi-fi, charging facilities
- **Real-Time Information**
  - Give customers **real-time information about crowding**
- **Greater Automation and Reliability**
  - 26% reduction in delay incidents **moving from manual driving to Automatic Train Operation** – WMATA already well designed

High Levels of Frequency and Capacity

14 of 34 CoMET and Nova Metros Already Operate at Least One Line At or Above 30 Trains per Hour (Every 2 Minutes)

Maximum Trains per Hour in CoMET and Nova Metros (Latest Available Data)



Previous Academic Research Has Shown That Improving Service Quality Is More Effective Than Reducing Fares

Elasticity of demand with respect to..	Elasticity
Income	+0.18
Fares	-0.33
Service Capacity (frequency, train capacity)	+0.51

Graham, Crotte, Anderson, 2009 using CoMET and Nova data

- **Cutting service levels to save money** is a no-win proposition and may set off a "death spiral"
- Ensure that **both costs and revenues are considered in decision-making**
  - Set service levels to **maximise outputs** and based on potential for new revenue
  - **More service can pay for itself**: 30-40% increase in capacity = 15-20% increase in revenue (on average)
  - Off-peak service typically has **low marginal costs** and many cities are experiencing significant growth at those times

Flexible and Learning Organization with a Continuous Improvement Culture

Barcelona Metro: “Goal is for staff to do whatever it takes to make the metro work”

Balanced Scorecard Approach Used by CoMET and Nova: Good Metros Have to be Good at Everything!

Growth, Learning & Innovation

G1a/b % Change Network Size & Passenger Journeys
G2a/b % Change Operated Capacity km & Car km
G3 Number of Training Hours / 1000 Staff Hours
G4a/b Non-Fare Commercial Revenue / Fare Revenue & /Passenger Journey

Financial

F1 Total Commercial Revenue / Operating Cost
F2 Operating Cost / Revenue Car km
- F2a Service Operations Cost / Car km
- F2b Maintenance Cost / Car km
- F2c Administrative Cost / Car km

F3 Investment Cost / Car km
F4a/b Operating Cost / Passenger Journey & km
F5a/b Fare Revenue / Passenger Journey & km

Customer

Capacity Provision & Utilisation

C1 Capacity km / Route km
C2 Passenger km / Capacity km

Service Quality

C3 Passenger Hours' Delay / Passenger Journey
C4 Passenger Journeys On Time / Passenger Journey
C5a/b Trains On Time / Total Trains (scheduled + actual)
C6 Hours of Train Delay / Train Hours Operated

Accessibility

C7 % Stations with Step-Free Access

Internal Processes

Reliability & Availability

P1a/b % Cars Available & Used in Peak Hour
P2a/b Car km / hours between Incidents (by category)

Efficiency

P3 Passenger Journeys / Staff + Contractor Hours
P4a/b Capacity & Car km / Staff + Contractor Hours
P5 Train Hours / Driver Hours
P6 % Employee Absenteeism
P7 Traction Energy Consumed / Car km
P8a/b Total Energy Consumed / Passenger Journey & km

Safety & Security

S1 Total Fatalities / Passenger Journeys
- S1a Deaths from Suicide / Passenger Journeys
- S1b Deaths from Accidents / Passenger Journeys
- S1c Deaths from Illegal Activity / Passenger Journeys

S2 Incidences of Crime / Passenger Journeys
S3a/b Staff Lost Time through Accidents / Staff Hours

Environment

E1 CO2 per Passenger km

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Closing Remarks

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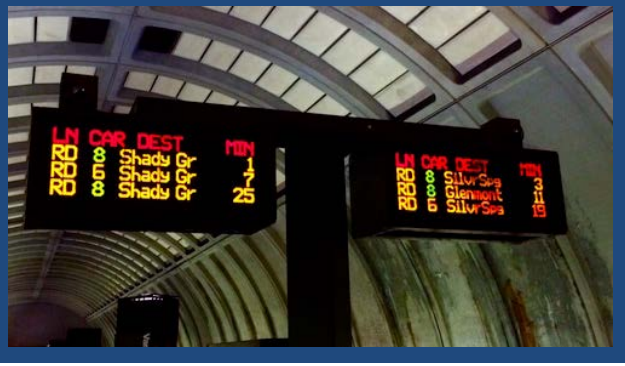
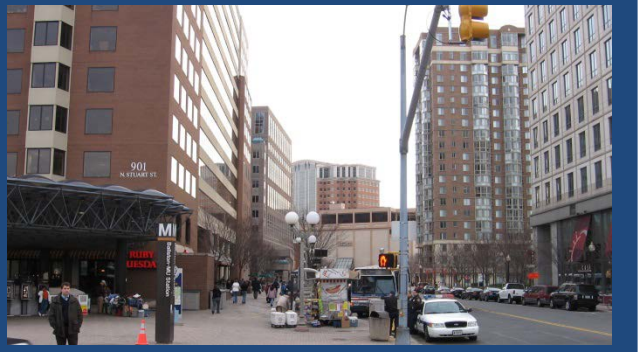
Strengths of the Washington Metro: An Invaluable Resource for the Region with a Lot to Build On

Good practice sustainable fares policy in place: distance-based and regular increases

Built for future capacity with the potential for 8-car, 600-foot trains and greater automation



Transit-Oriented Development (e.g. Arlington corridor) and intermodal connections



Summary: What Can We Learn From World-Class Metros?

- Sustainable Fares and Secure Funding
- Well-Managed Safe and Secure Environment
- Holistic and Mature Approach to Asset Management
- Customer-Oriented Focus on Service Quality
- High Levels of Frequency and Capacity
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Conclusions:
How Can You Afford Not to Make the Most of the Metro?

- **Investing and supporting WMATA is necessary, expensive, and will take time**
  - **It is a big job – full alignment among stakeholders regarding goals and expectations is necessary to make this work**
  - **Everyone must recognize what it costs to run and sustain a metro system**
  - **Costs will be more than worth it in the long term – the Metro is a key element of regional mobility and brings significant economic benefits for the region**

- **Essential to restore confidence and trust and establish a virtuous circle rather than a death spiral**

- **Not alone: shared challenges and good practices around the world**

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Thank You!
Any Questions?

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