Maximizing the potential for metros to reduce energy consumption and deliver low-carbon transportation in cities

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Presentation Structure

- Introduction to CoMET, Nova and Imperial College London
- Climate change & energy: critical issues for metros
- The carbon efficiency of CoMET and Nova metros
- Best practices in reducing energy consumption
- Conclusions

Community of Metros

CoMET

Nova

Group of metros

Why do CoMET and Nova exist? Urban railways share similar problems and challenges and can share solutions

"We try to be best and very often are, but CoMET is very beneficial to us as it opens our eyes to things we might not have seen before".

Andrew McCusker, Operations Director, Hong Kong MTR / CoMET 2009 President

CoMET and Nova compare metro performance to identify and share best practices

This presentation is developed from recent benchmarking studies

- **Imperial College**: CoMET and Nova's facilitators and analysts
- **Research** for metros has been completed on:
  - Best practices and technologies in **energy reduction**
  - Understanding and estimating the **carbon footprint** of metros
  - Identifying strategies to ensure metros remain **competitive** with other transport modes on a carbon basis

The Carbon Footprint and Metros

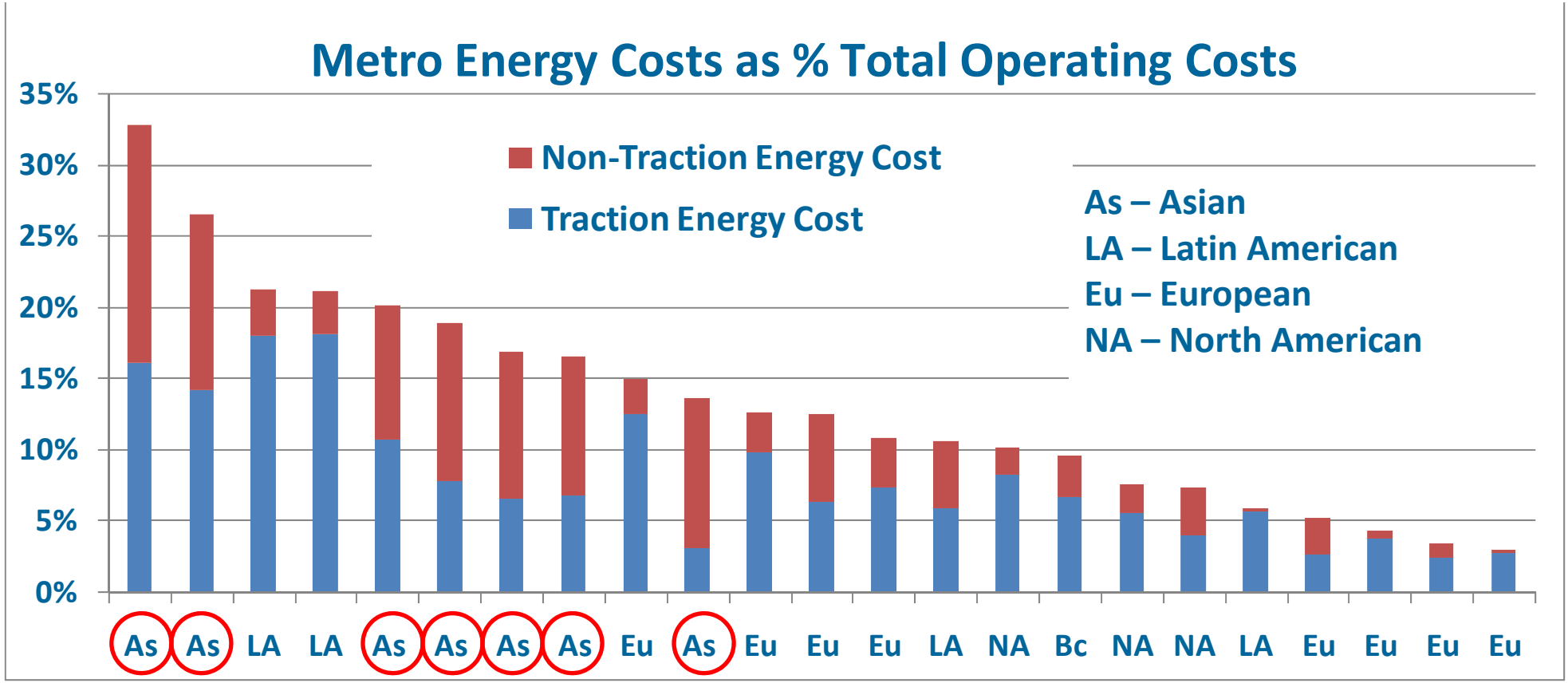
- A measurement of all greenhouse gases (GHG) emitted directly and indirectly and has units of tonnes (or kg) of carbon dioxide equivalent.

- **Most metros do not have a zero carbon footprint – electricity sources should be taken into account**

- **But metros have the potential to deliver wider CO_2 – saving benefits which are not easily measured**

Why should Asian metros worry about energy consumption?

Typically energy costs are 20% of an Asian metro's operating costs
But what if energy prices doubled in the future?



Source: CoMET and Nova Metros

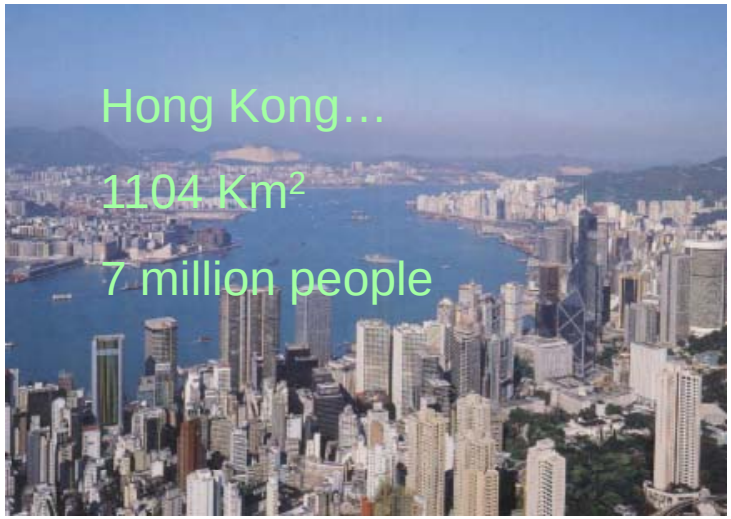
Metros, Energy and Carbon: Why is it important in a policy context?

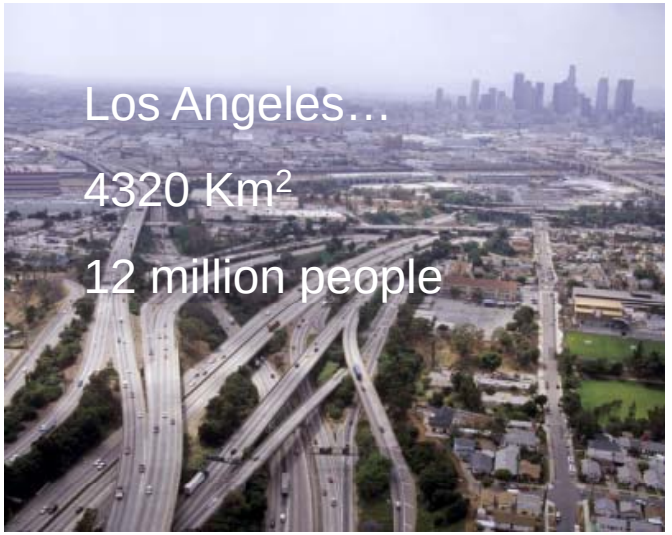
Policy context in the medium to long term	Metros Need to...
National carbon targets & budgets common: transport policies & spending affected	Ensure that policy-makers understand the wider environmental benefits of metros
Competing transport modes (bus, car) will become more energy efficient	Implement energy reduction strategies to minimize carbon footprint and energy costs
As energy becomes de-carbonised (nuclear, renewable) energy costs will rise	Be prepared to take advantage of new funding sources arising from emerging carbon markets

Developed, dense, low-carbon cities simply cannot exist without metros

Metros facilitate compact, sustainable, low carbon cities – this message must be heard in any discussion about metros' carbon footprint.

- Without a metro, cities can sprawl as car ownership rises, longer distances are travelled and houses and buildings become bigger, consuming more energy
- Metros allow cities to become denser
- A 10% increase in urban density = 3.5% less fuel consumption

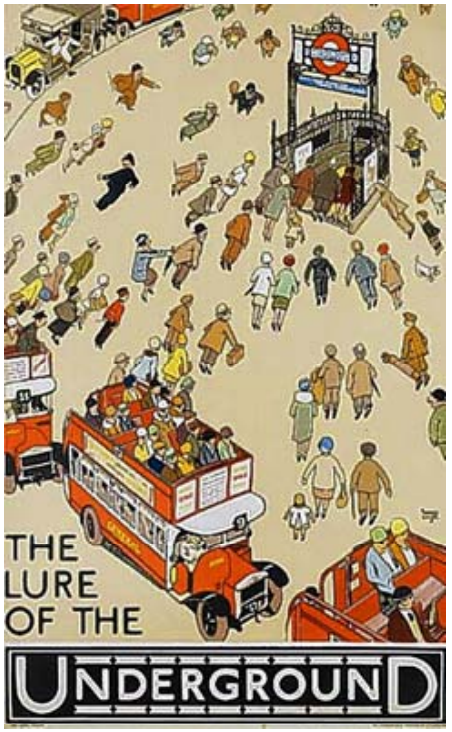




Metros' Role in Decarbonising Society

- A metro's carbon footprint from energy will be off-set either partly or wholly by wider environmental benefits
- Level of success depends on integration with land-use and other transport modes
- The decarbonisation of transport relies on two concurrent strategies:

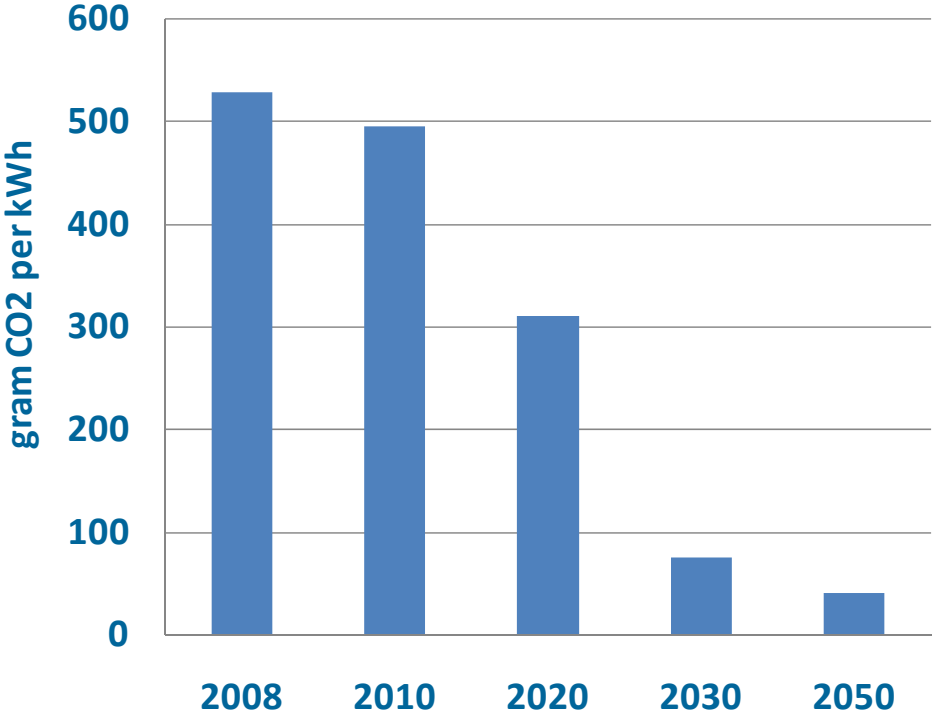
1. **Electrifying transport (metros, electric cars)**
2. **Decarbonising electricity supply (nuclear, renewable)**



Metros play a key, positive role in the long-term aim to de-carbonize transport and to support sustainable cities

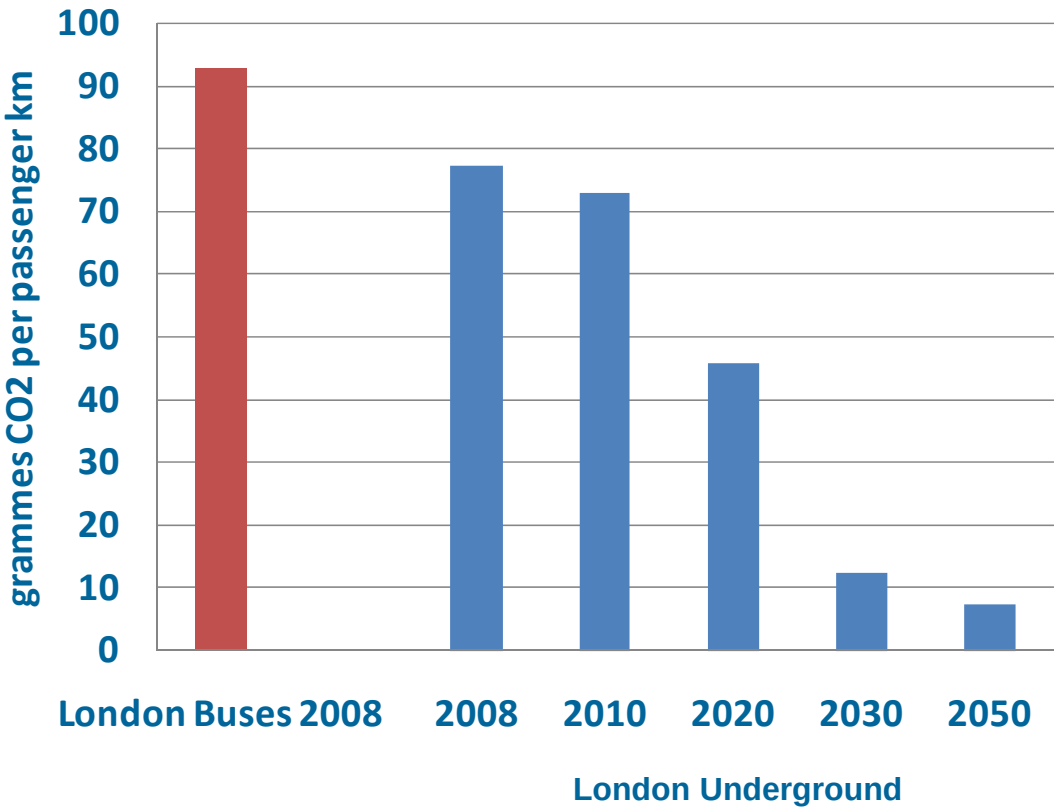
De-carbonizing electricity supply will have a significant impact on the metro's electricity-related carbon footprint

UK: Proposed De-carbonization of electricity production



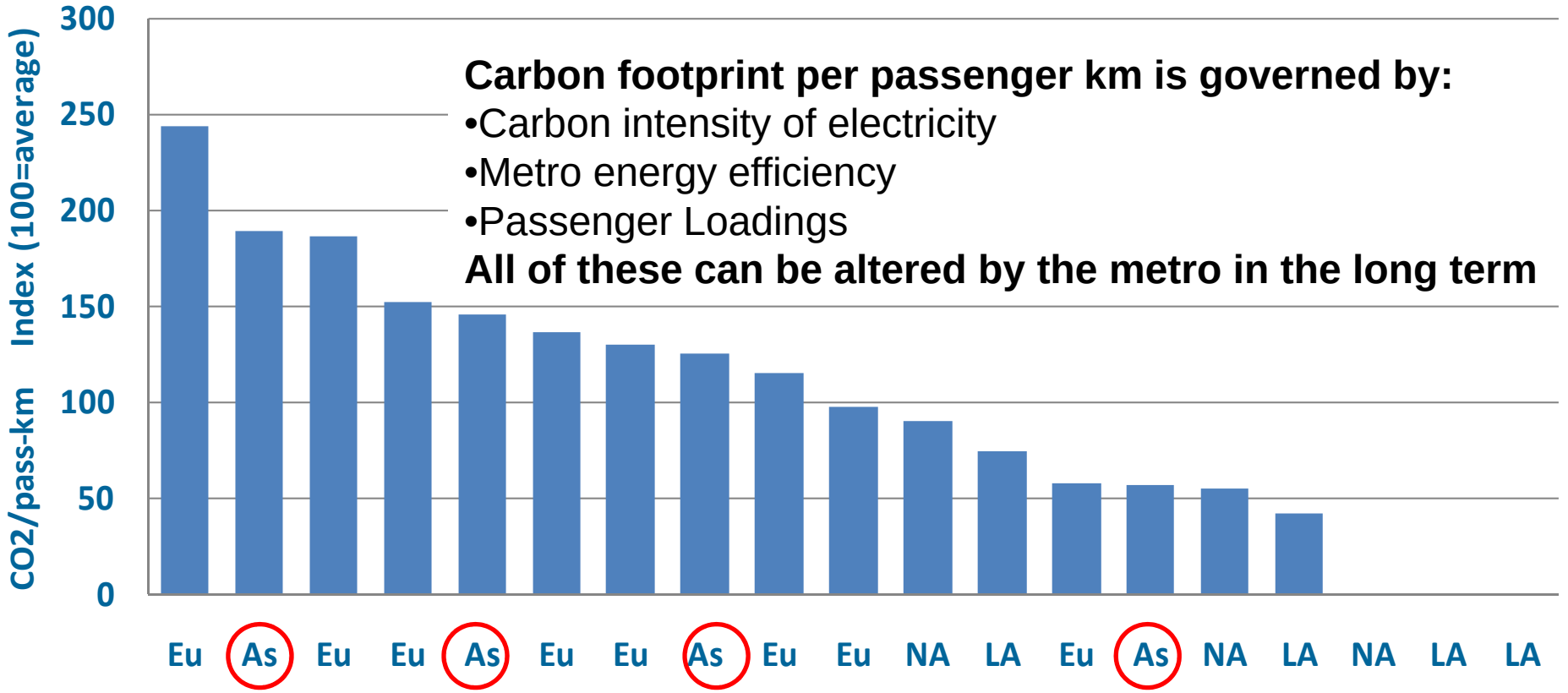
Source: UK Committee on Climate Change

Impact of CCC Projections on London Underground



Metros have variable carbon footprints arising from their energy use

Carbon Footprint of Metros
Electricity Use Per Passenger Kilometre



Carbon footprint per passenger km is governed by:

- Carbon intensity of electricity
- Metro energy efficiency
- Passenger Loadings

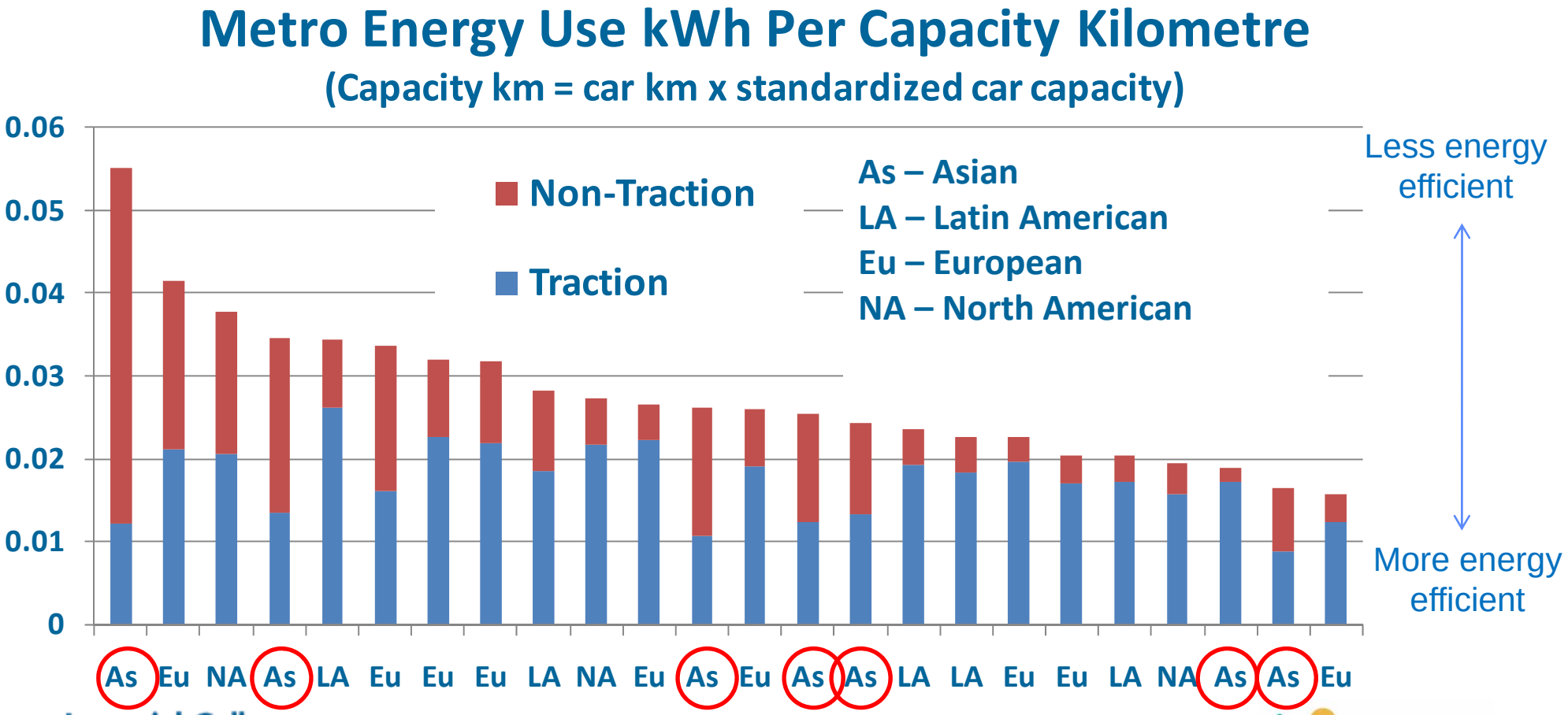
All of these can be altered by the metro in the long term

Coal generated electricity
Low passenger loadings
Inefficient use of energy

Hydro-electric generated electricity
High passenger loadings
Efficient use of energy

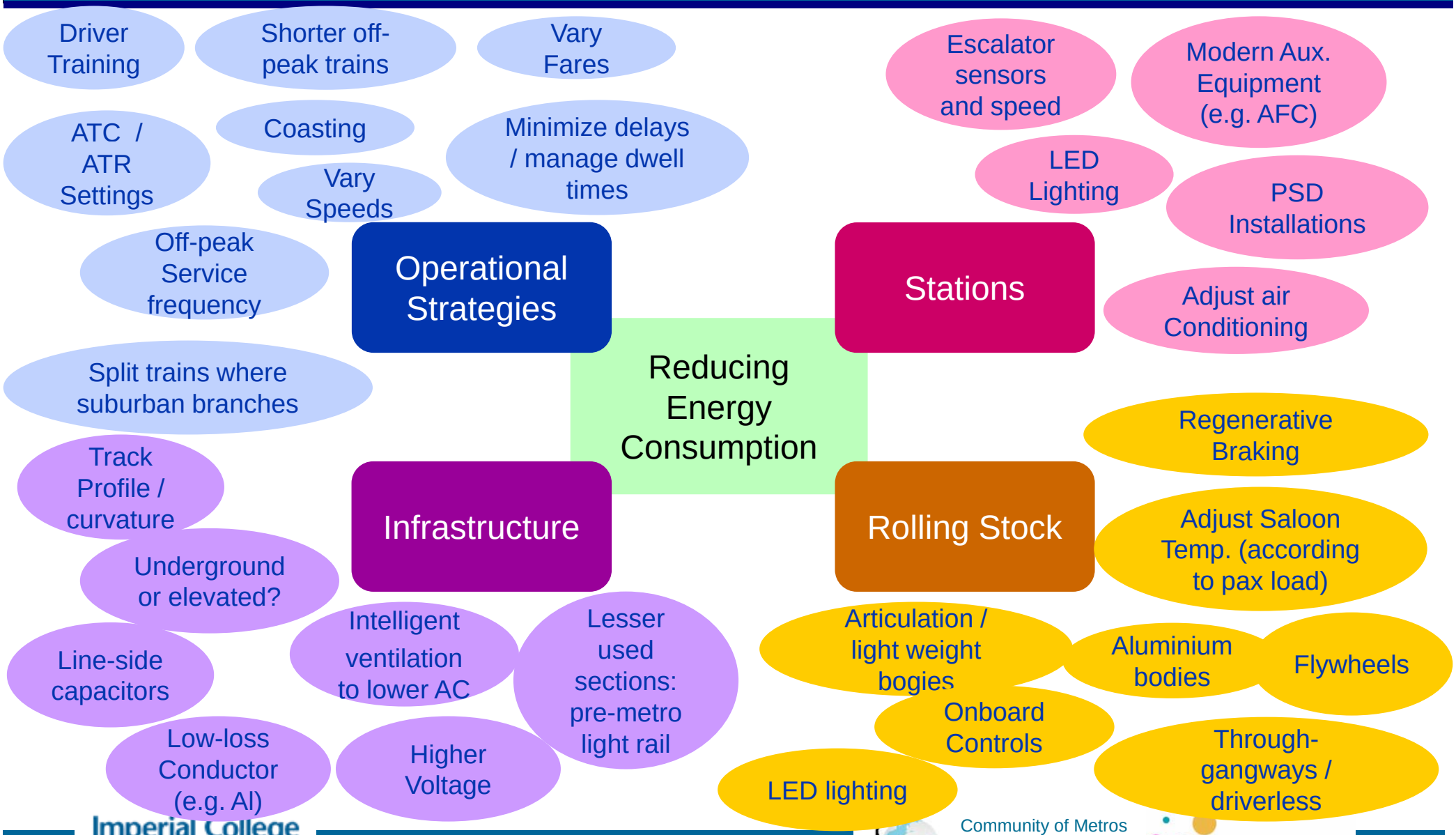
Large differences in energy usage between metros (a factor of 3) = potential for many metros to become more efficient

Asian metros are often affected by large station air-con requirements and these have been a focus by some for reductions in energy

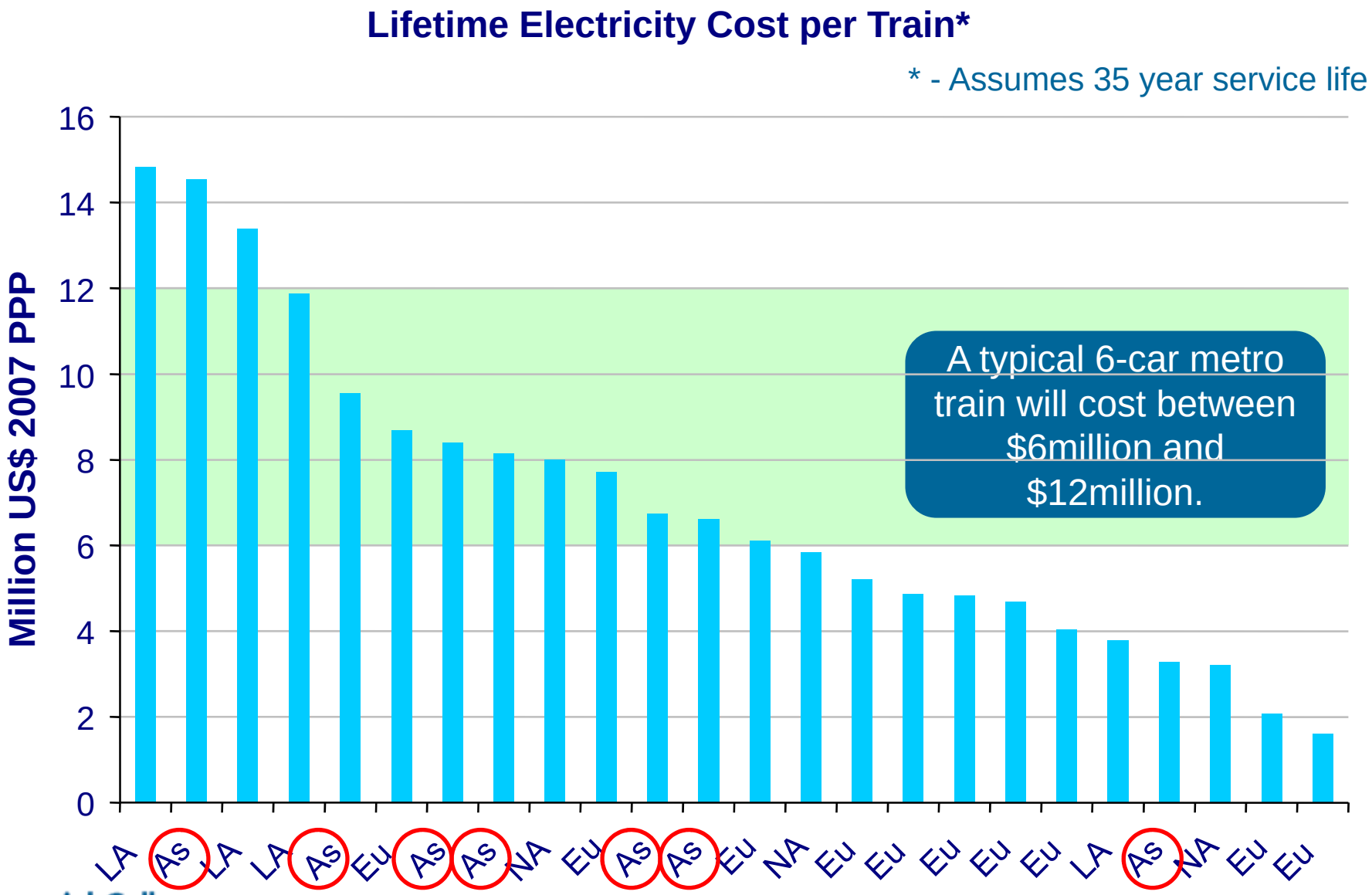


Source: CoMET and Nova Metros

A strategy for energy reduction: the accumulation of individually small changes over time



Lifetime energy costs per train exceeds purchase price for many metros



Example 1: Hong Kong MTR – Standardised LED Lighting

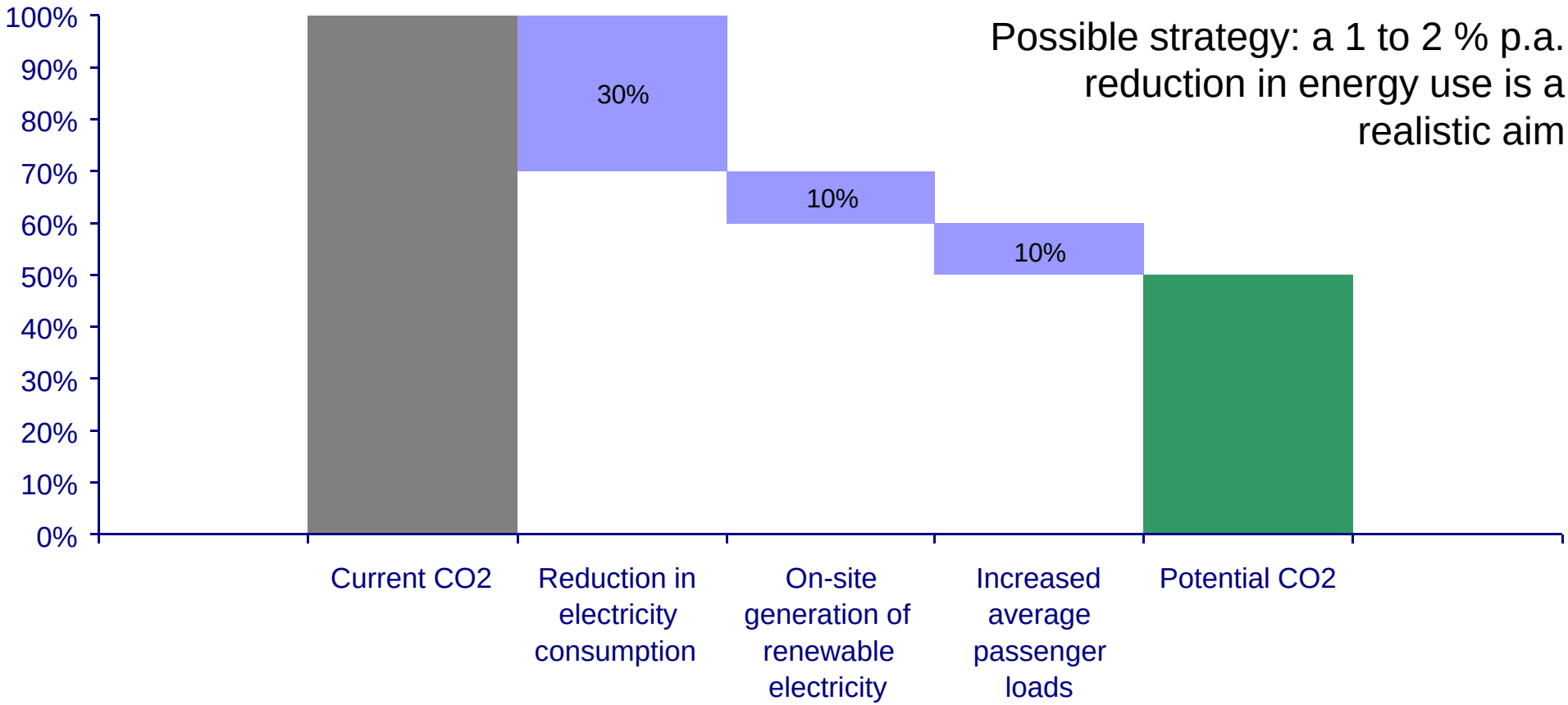
- MTR have developed and tested a specification for LED lighting installation in trains and stations;
  - LEDs save energy and maintenance.
  - Drop-in replacement for existing lighting equipment
  - 40% saving in lighting energy

Example 2: Local Generation of Renewable Electricity

- **Nova study: 10% of required electricity using on-site renewables is feasible**
- Rail depots = ideal locations for wind turbines?
- Calgary light rail system: powered by 12 wind turbines
- London Underground would require approx. 50 turbines to generate 10% of it's electricity requirement.
- Micro-turbines, mounted on stations?
- Solar panels on rooftops (e.g. depots)?
- Wind payback 3 to 5 years. Solar longer

Is a 50% reduction in CO_2 per Passenger/Km possible?

Halving a metro's CO_2 emissions per passenger/Km is within reach…



Possible strategy: a 1 to 2 % p.a. reduction in energy use is a realistic aim

Sourcing electricity from renewable and nuclear sources will enable further reductions.

Conclusions – Energy and Carbon Reduction

- **New metros**: build-in energy optimal design at every stage
- **Established metros**, energy / emissions reductions of 1 to 2% p.a. are a realistic aim
- **Operational strategies are critical** (ATR/ATC, coasting, off-peak speeds, minimizing delays, etc.)
- **Longer-term**, consider altering energy supply through on-site renewable and direct-feed from off-site renewable generation

Final Comments

- Shocks in energy prices are a key risk for many Asian metros
- Beware of unfair comparisons of CO_2 for metros vs other modes
- Metros have far wider environmental benefits than are immediately measurable
- Beware of unintended consequences (e.g. reducing capacity to reduce energy but also reducing attractiveness of the metro)

Metros play an essential, positive role in the long-term aim to de-carbonize transport and to support sustainable cities

Thank you for your attention

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