

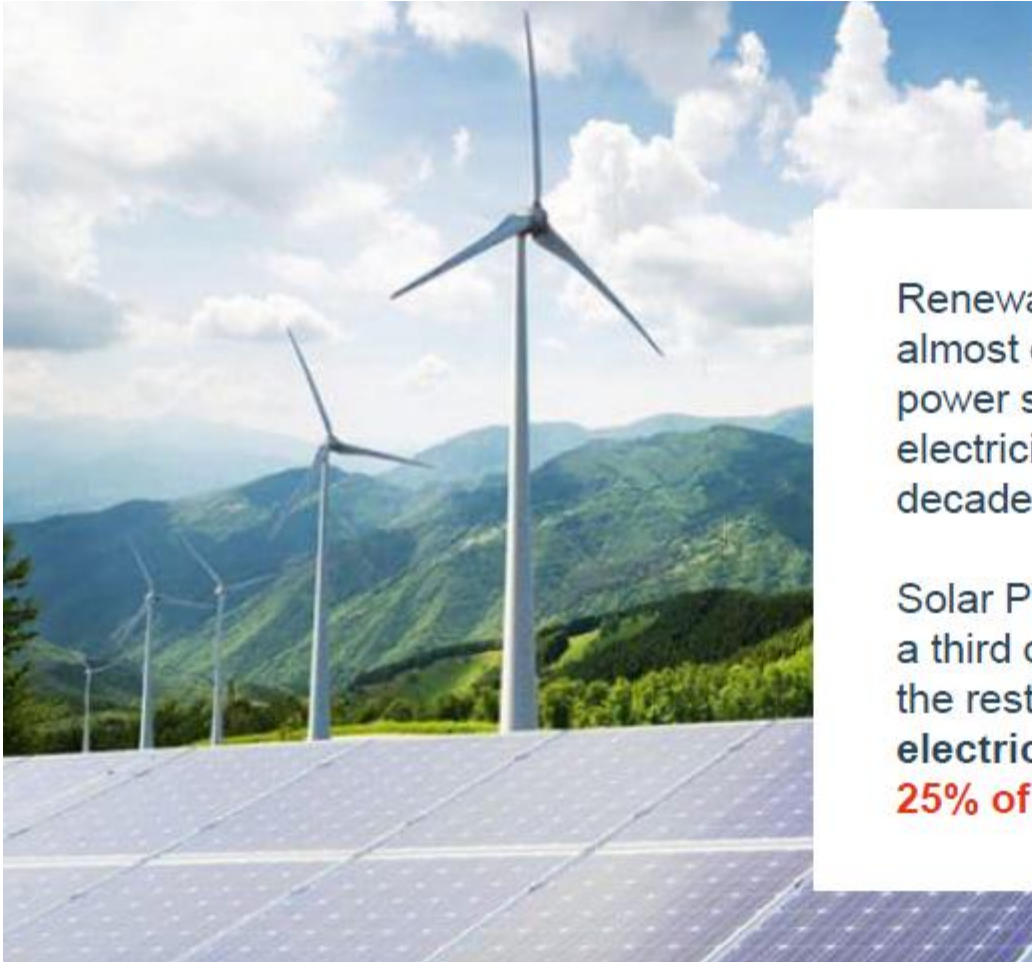


Renewable Energy meets Modern Mobility

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Good news: Renewable energy production increasing globally



Renewables **increased by 4% in 2018**, accounting for almost one-quarter of global energy demand growth. The power sector led the gains, with renewables-based electricity generation increasing at its fastest pace this decade.

Solar PV, hydropower, and wind each accounted for about a third of the growth, with bioenergy accounting for most of the rest. Renewables covered almost **45% of the world's electricity generation growth**, now accounting for **over 25% of global power output**.

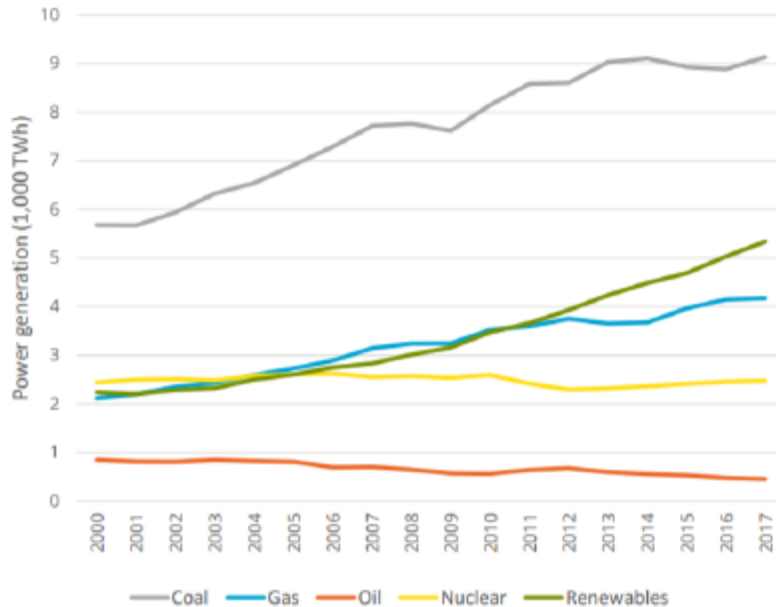
Source: Alstom - AKKA

Renewables represent strongest growth across the world

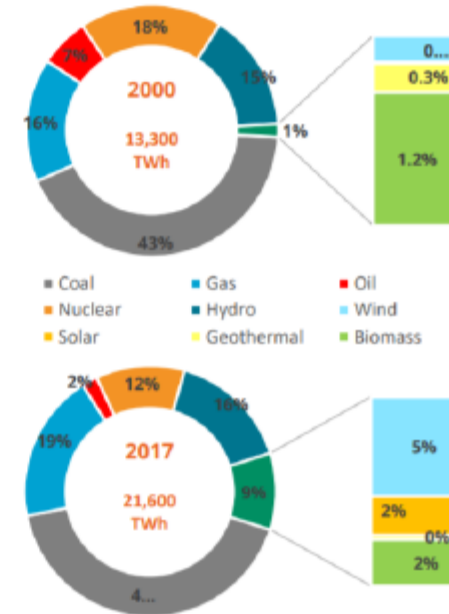


THE STRONGEST GROWTH COMES FROM RENEWABLES (EXCLUDING HYDRO), + 23% IN 2017

Power source evolution – G20 countries



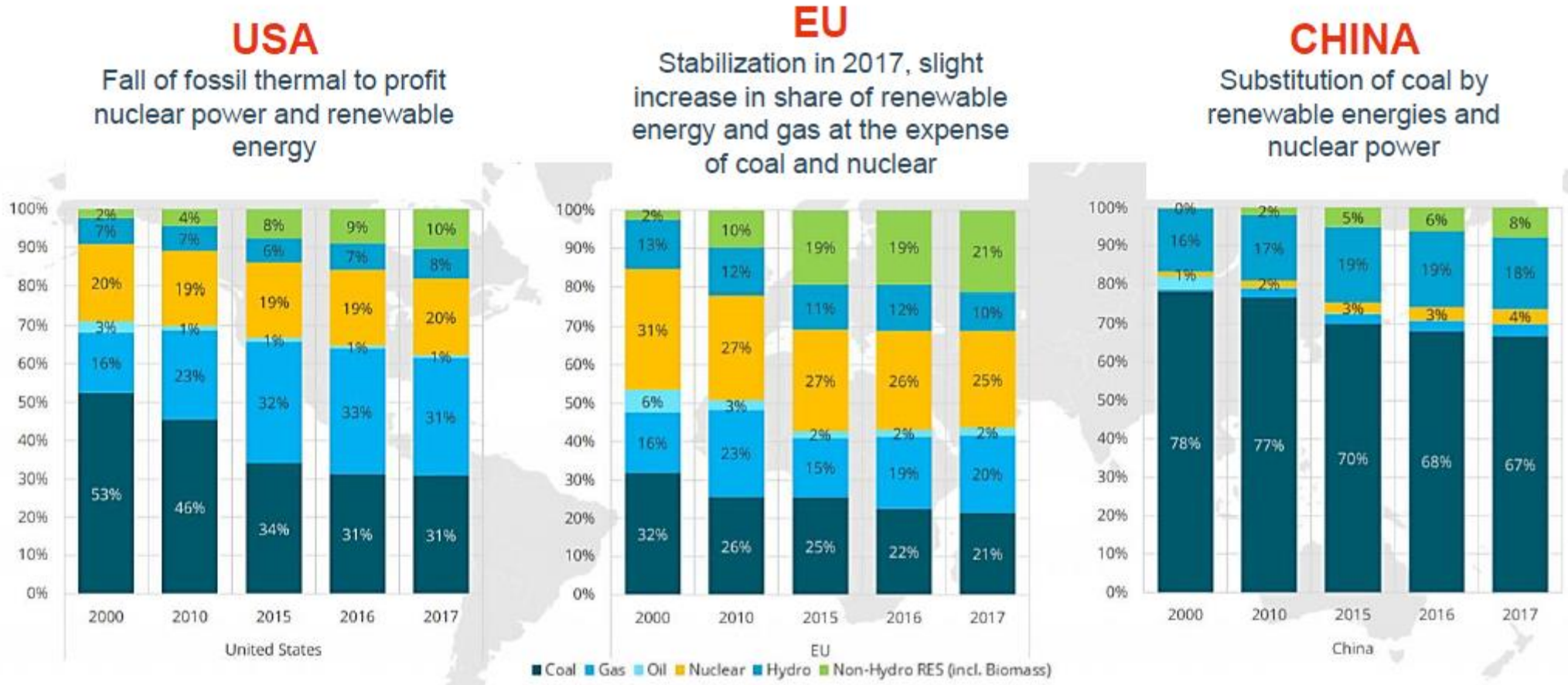
Power mix – G20 (2000 - 2017)



Source: Alstom - AKKA

Evolution of electricity mix in main countries

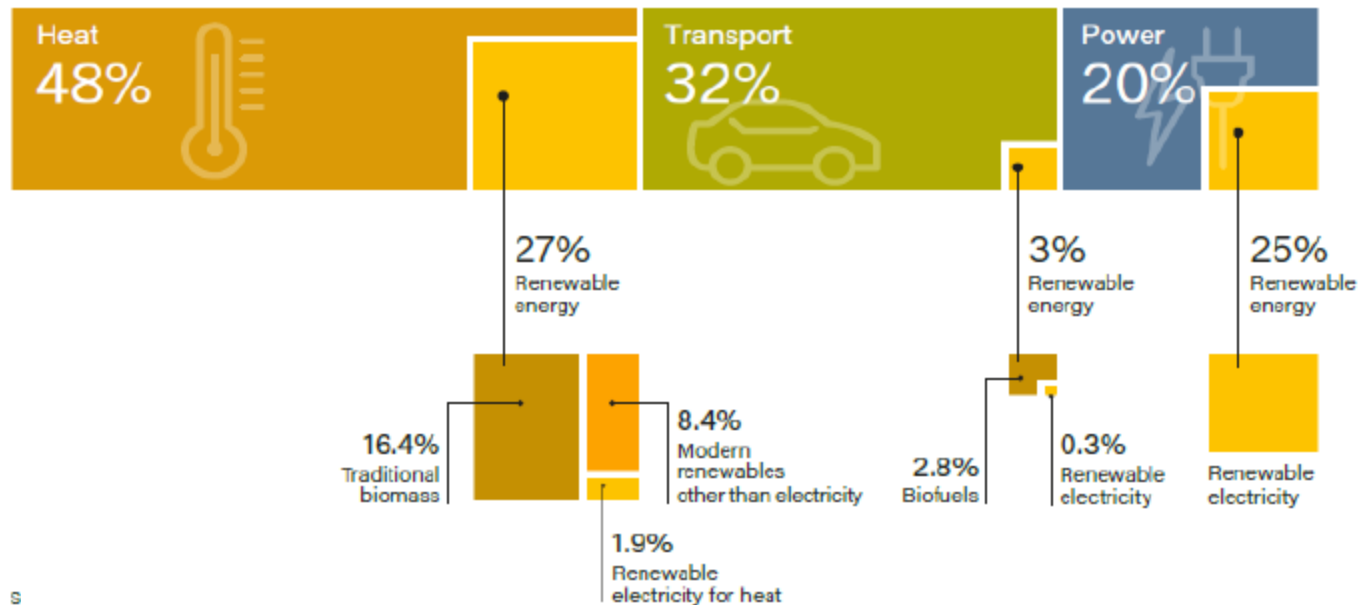
Renewable energy production has doubled in past 20 years



Source: Alstom - AKKA

Transport is major energy user, but lags other segments in renewable usage

Transport is 2nd major source of energy consumption



Problem(s) to solve...

In cities, mobility: Rail, Bus, Auto, Bicycles, Scooters, Shuttles all moving to electrification...

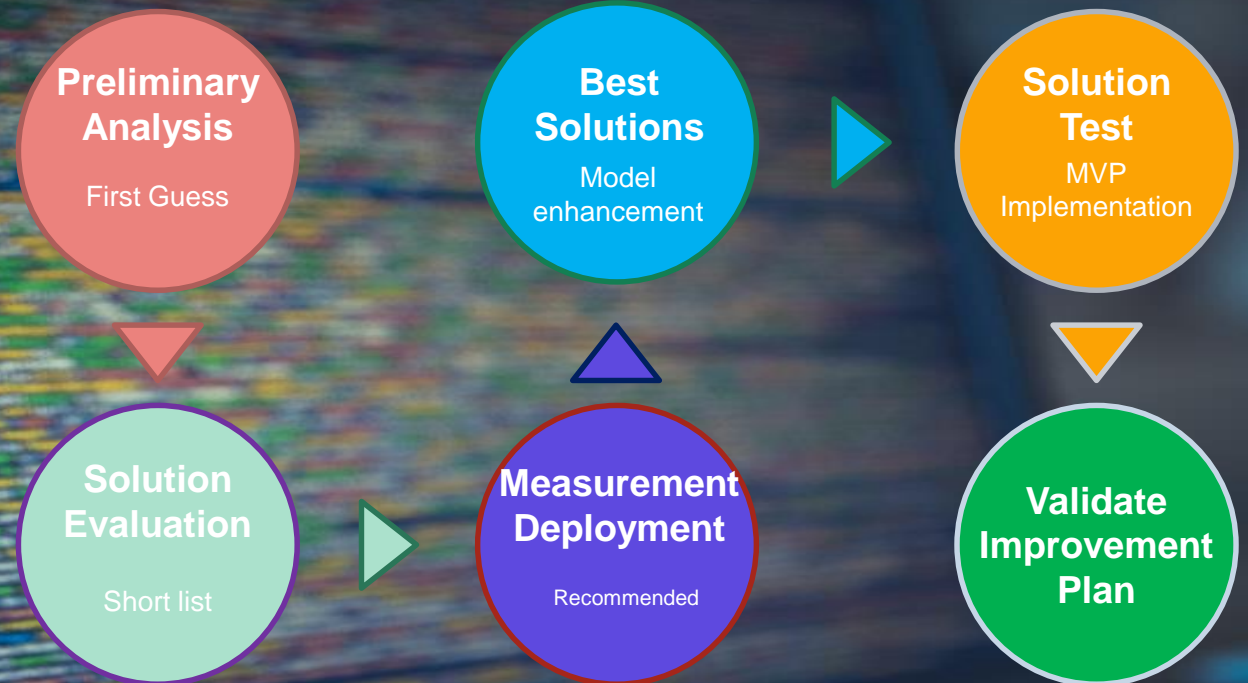
- 1 How do we connect renewable energy to the proper grid and then to mobility vehicles?
- 2 How do we empower consumers to know the sustainability of their mobility choices (efficiency & CO₂)?

Source: Alstom - AKKA

Mobility systems are increasingly complex...How to address energy challenges?

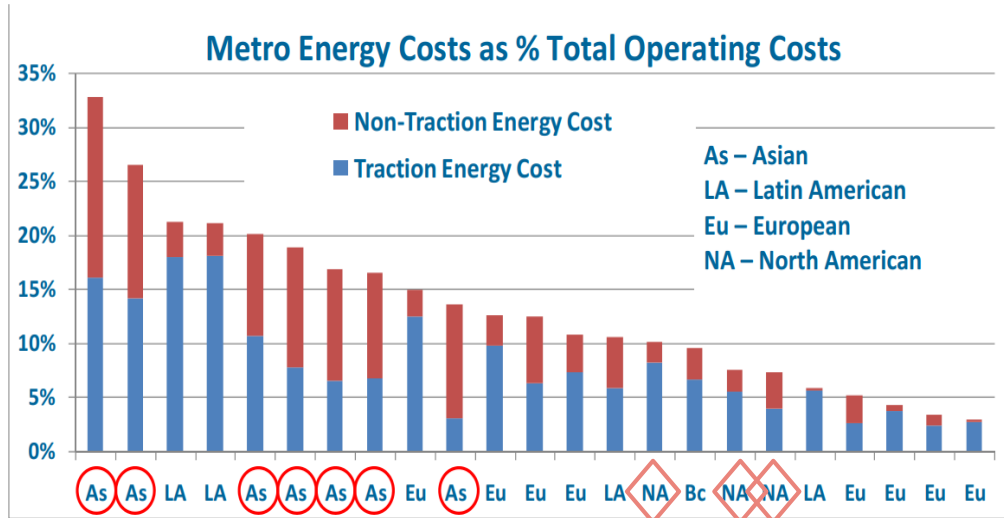
Select 1 focus area: identify how to Measure, Analyze, **INNOVATE**, Manage

- **Data Accessibility & Optimization** (decision making)
- **Product/Vehicle** (mobile assets)
- **Infrastructure/System** (fixed assets)
- **Interconnected Multimodal Trips** (optimize for trip time & energy consumption)
- **Operating Behavior level** (human factor variability)



Vehicle example: Innovation can bring OpEx, Energy use and CO2 reductions

North American metro energy costs are ~10% of OpEx & lifetime energy cost > cost of new train

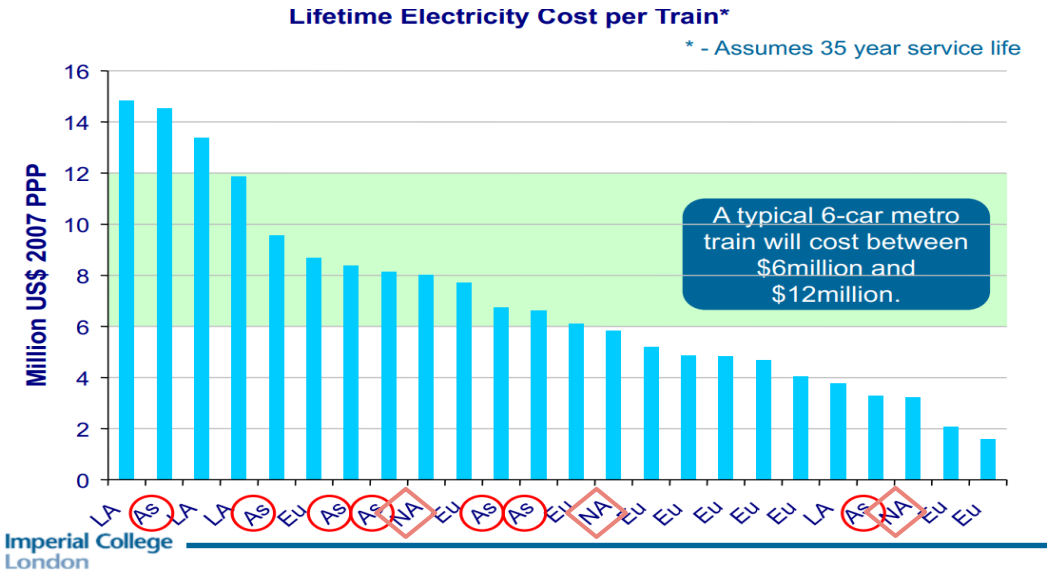


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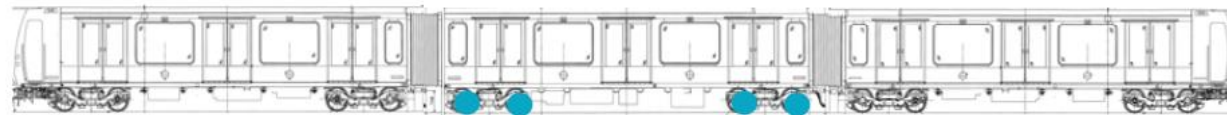
Source: CoMET and Nova Metros



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1/3rd Acquisition

1/3rd Energy

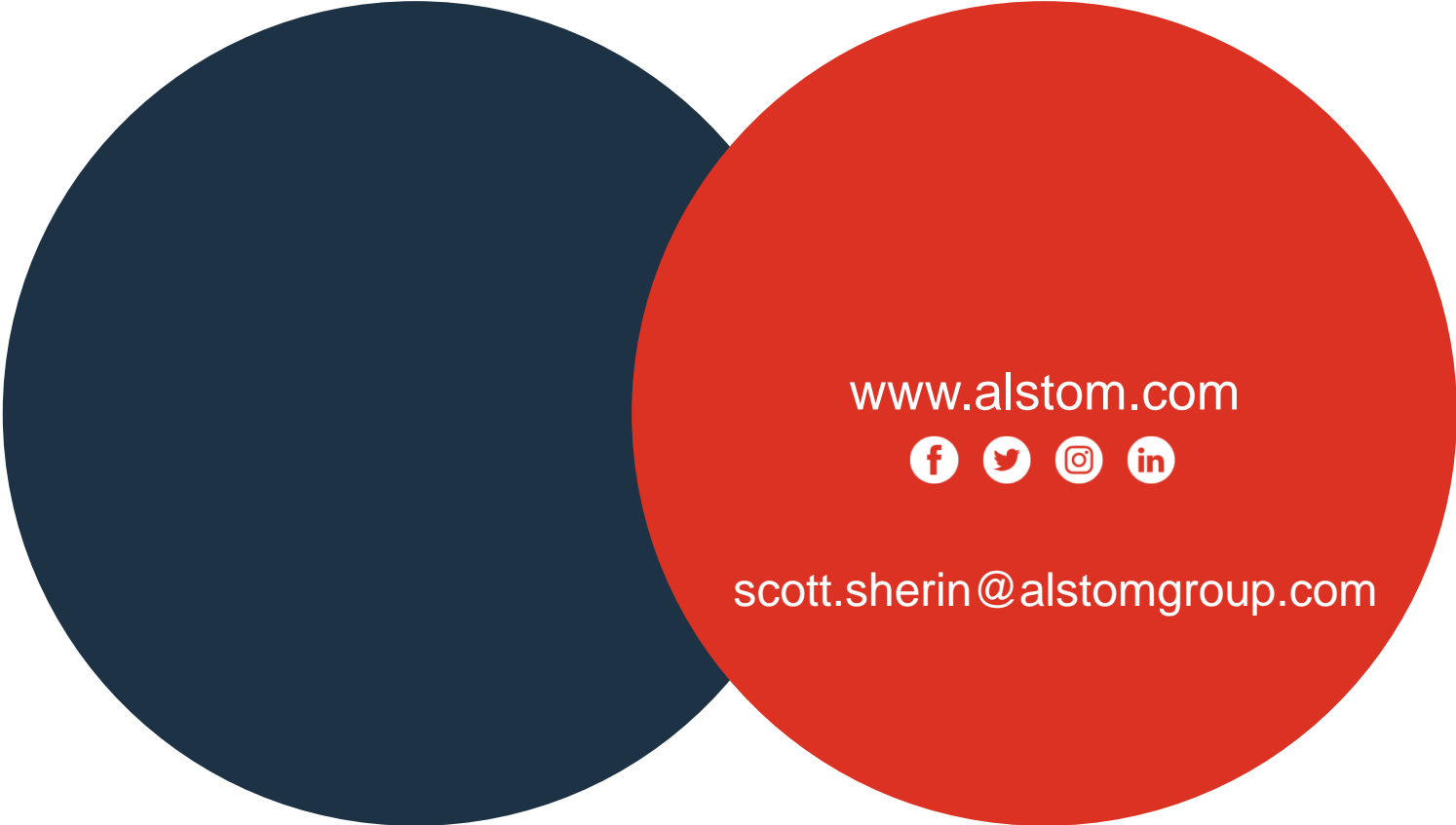
1/3rd Maintenance



Problem statement

For mobility and transportation to enable a carbon free Washington DC, we must first:

Adopt a **data-driven** approach to **measure and analyze** where in our **multimodal system** we have the best opportunities to **innovate vehicles and infrastructure** and **optimize operating behaviors** to achieve quick, sustainable benefits



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