

An aerial photograph of Johannesburg, South Africa, showing a dense urban landscape with various buildings, roads, and green spaces. The image is used as a background for the text overlay.

**Shaping the Green Transport Roadmap in the City of
Johannesburg:
En-route to Electrifying Public transport
Alex Bhiman, CoJ Transport
EVIA Conference 6 December 2017 IDC Sandton**

The logo for Joburg, featuring the word "Joburg" in a stylized font with a small graphic of a building or tower above the letter 'o'.

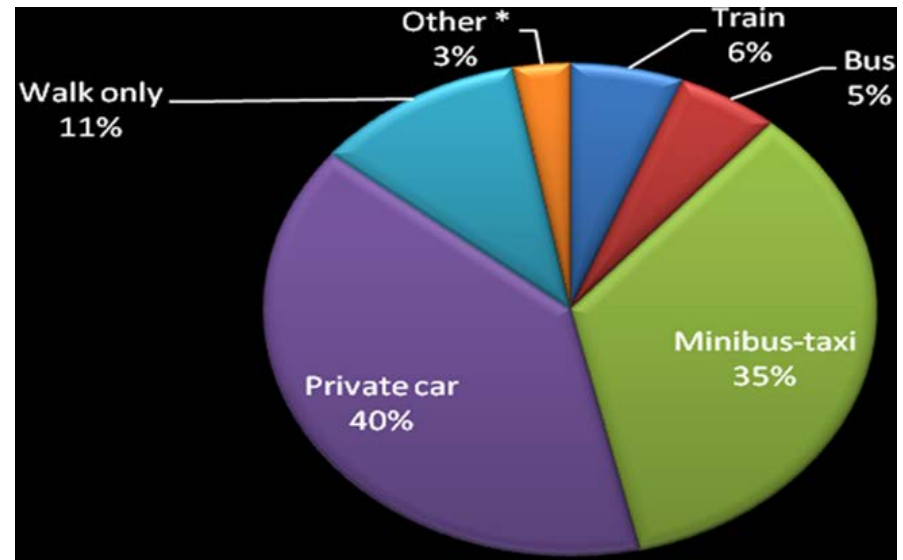
Joburg

a world class African city

Transport modes in Johannesburg (2)

- The main modes are:
 - **Private** vehicles
 - **Mini bus taxis** (not subsidised, privately owned – organised in associations)
 - Rail (Gautrain – high class and Metrorail – for the poorest)
 - **Bus** (City bus fleet, provincial subsidised, Rea Vaya BRT)

Specific challenges arise out of our apartheid spatial legacy (poor people on the periphery) and decades of car centred, security focused planning



Main mode to work

City vision for transport (3)

“A people-centred transport system that is transformed.”



We are guided by:

- Joburg Growth and Development Strategy 2040
 - Liveable city: Very **pro-public transport, walking and cycling (ecomobility)**
 - Radically increase public transport use
 - More compact city with future development around **public transport corridors**
 - Support economic growth
 - Actively engage the citizenry
 - Support entrepreneurship
 - **Job –intensive economy**
 - **Low-carbon city economy**
- National Public Transport Strategy
- National Development Plan

Corporate commitment and governance (4)

- **Previous Administration :**
 - Ensuring **that all new buses** for bus rapid transit or conventional bus use a **green fuel**, including **refleeting or conversion of existing bus fleets** with a green fuel
- **New Administration - A Joburg that works is a South Africa that works**
 - Priority 9 Preserve our resources for future generations
 - Outcome 2: Enhanced, **quality services** and **sustainable environmental practices**
 - **IDP 2017/2018 Identifies climate uncertainty - part of the current context. Strong commitment to climate change and resource efficiency (cost of different energy sources) as strategic foci**
- **Business Plan Focus - Refleeting with clean energy bus fleets**
 - **Contribute to City's goal of environmental sustainability**
 - **Achieve mandate for environmentally friendly public transport**

Diesel Dual Fuel Initiative (5)

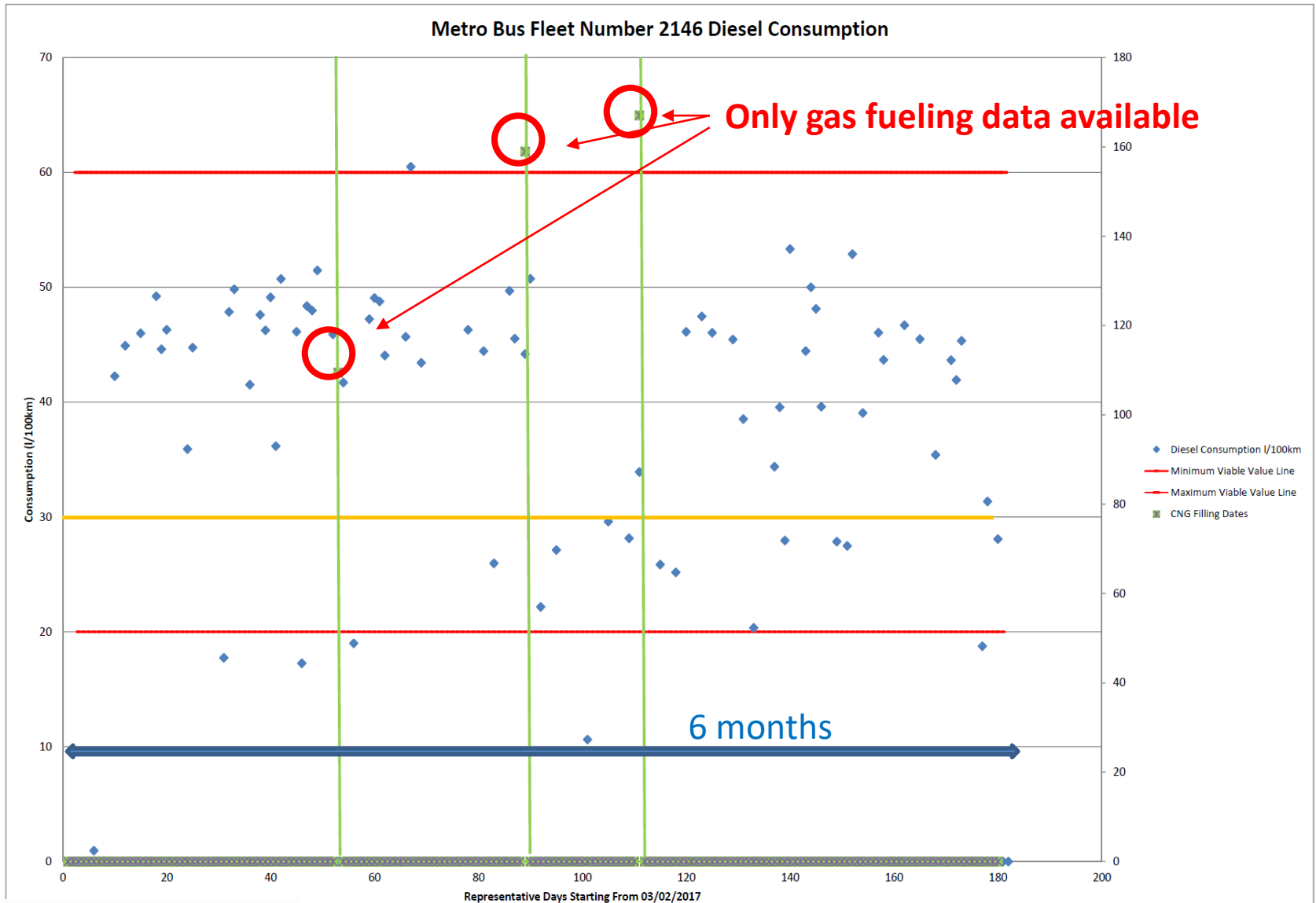


- 2011 – Beginnings in Metrobus Transformation in search of operational efficiencies and cost saving
- Dovetailed with City's growing profile as a leader in the global for a for environment and climate change: UNFCCC, C40, ICLEI
- Protocols : COP 21, C40 Charter, Clean Bus Declaration
- Hosting C40 Summit : Conversion of 2 buses
- Supported by IDC and SANEDI hosting a Summit and Expert Advisory Meeting leading to Mayoral decision in 2013 on DDF Technology as transition step.
- 2014 specs for two tenders awarded one for conversion of buses from old fleet to DDF and the other for procurement of buses with a DDF technology

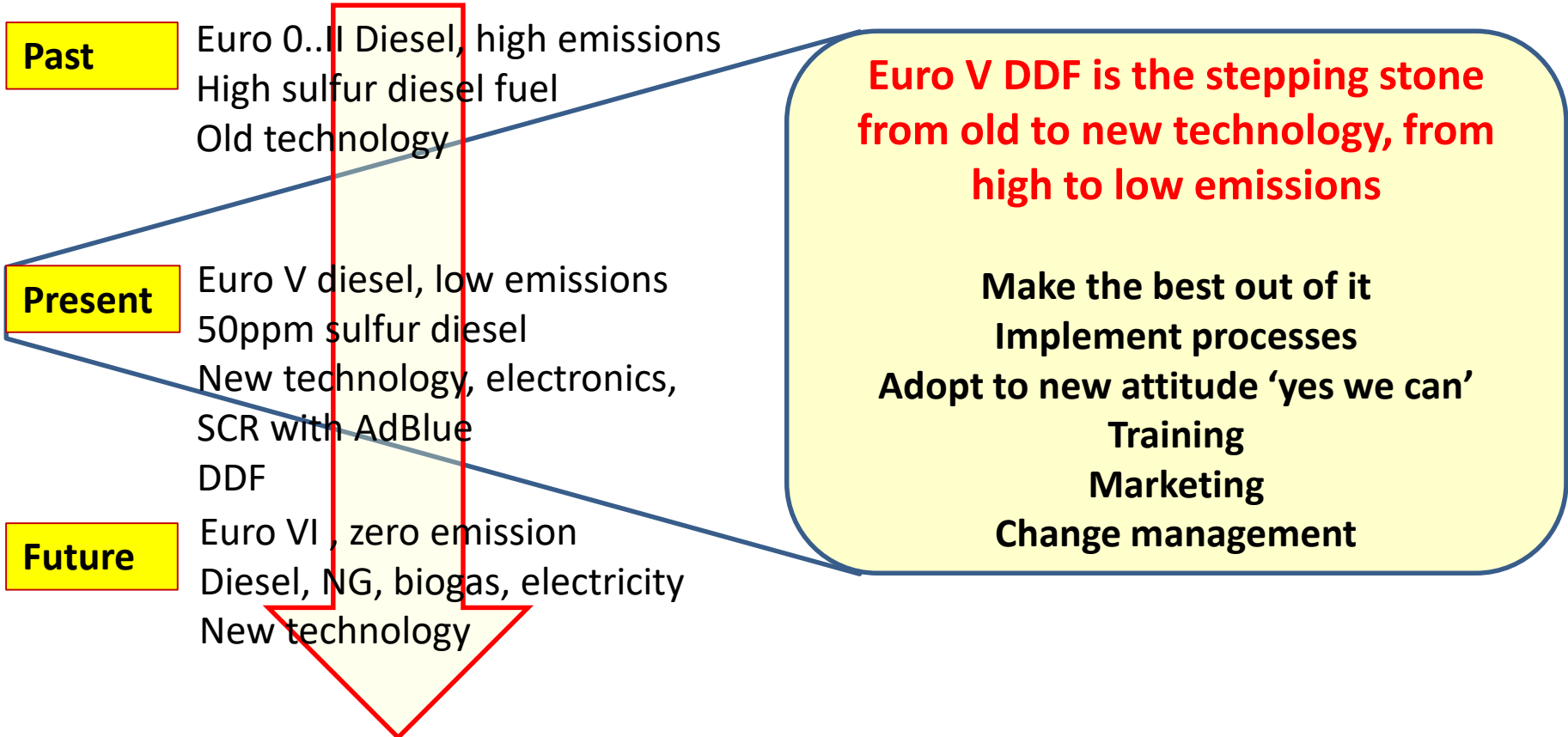
Where are we: DDF Status Quo (6)

- 150 Euro V DDF Buses are operational (can be operated as DDF)
- With Euro V we have reduced regulated emissions significantly, all other buses are **Euro I level and changing with all buses from 500ppm sulfur to 50ppm sulfur fuel**
- GHG emissions remain unchanged (contrary to expectations), but **cleaner fuel is used**
- Because of lacking gas fueling infrastructure only about 25% of the DDF fleet is running on dual fuel – in order to be more efficient two more filling infrastructures have to be installed (Roodeport and Village Main) or most buses to be allocated to Milpark depot
- Under the current operational conditions the **DDF is not cost effective**
- Processes have to be implemented / improved to make operation and maintenance more effective
- **Potential for biogas with the potential to reduce GHG emissions significantly**
- From procurement to operations the change to different fuel and technology requires new and additional technical skills
- Maintenance : Training to take over from OEM

DDF Fuel consumption data (7)



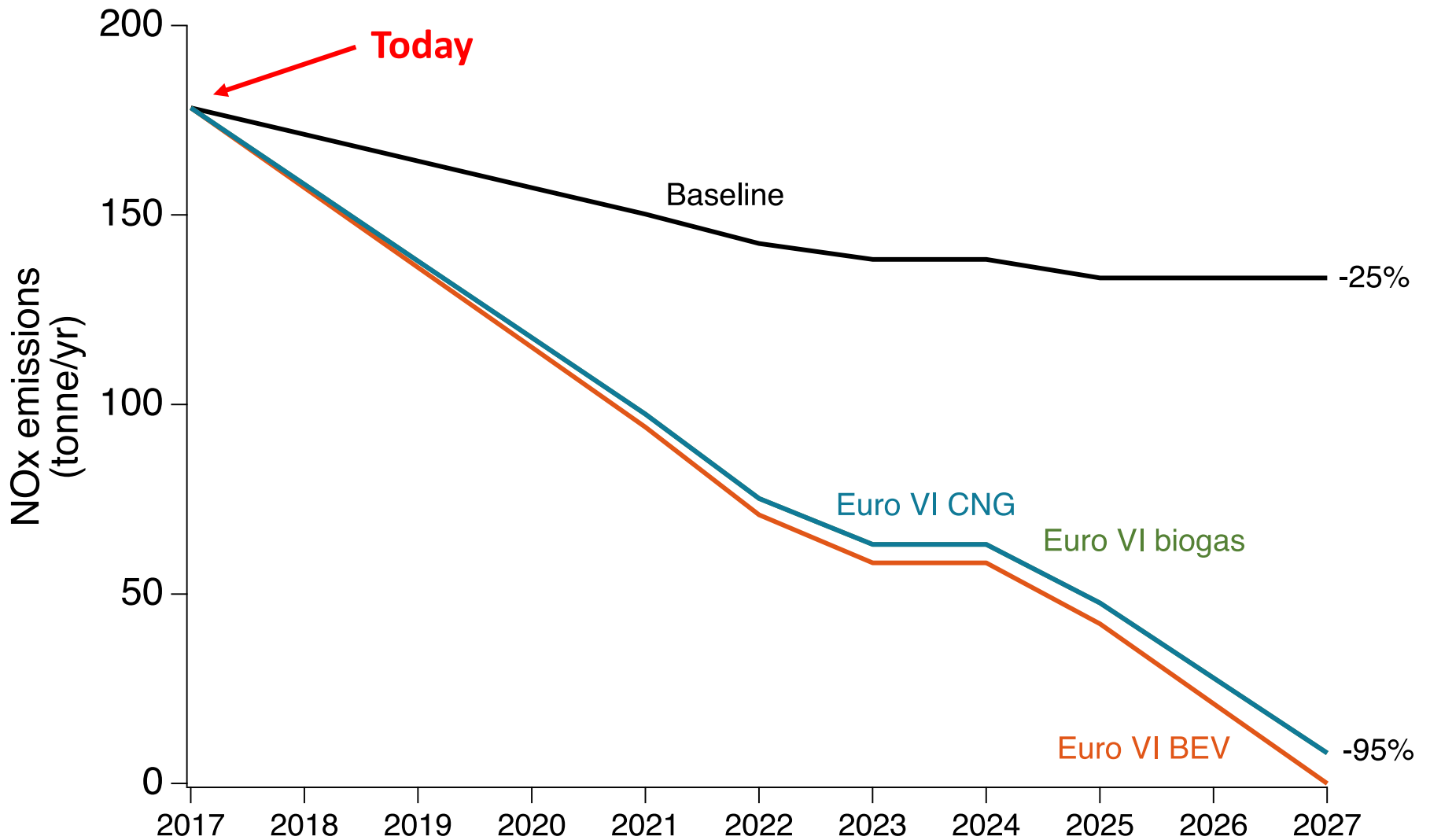
Going Forward Our Approach (8)



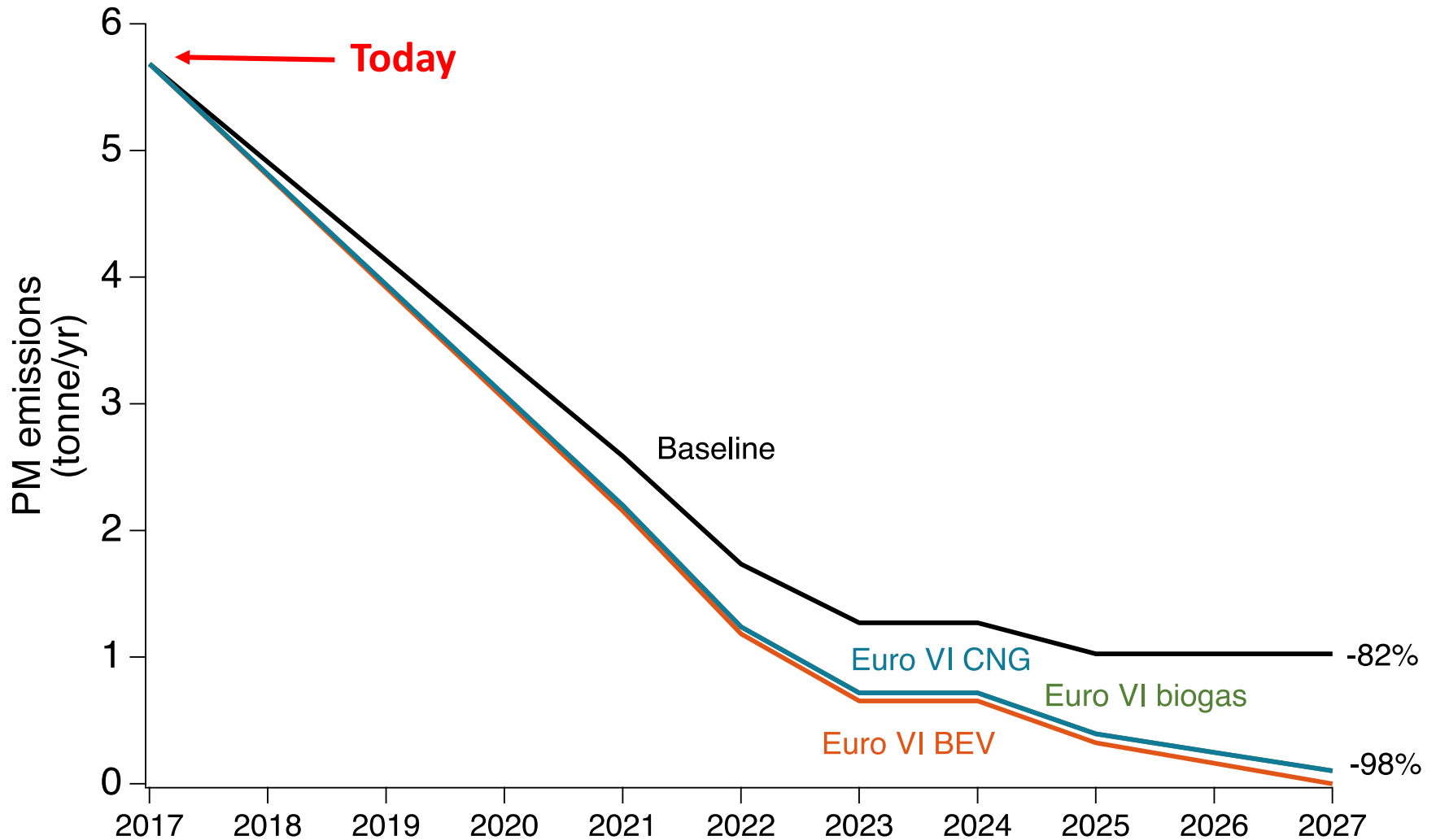
The value of DDF will depend on the next step. Build on this as a stepping stone towards a long-term transition to a clean, modern, and environmentally sustainable public transit system.

Or fall back to the cheapest options available, which is easy now but leaves us standing still and makes the problem worse in the longer term.

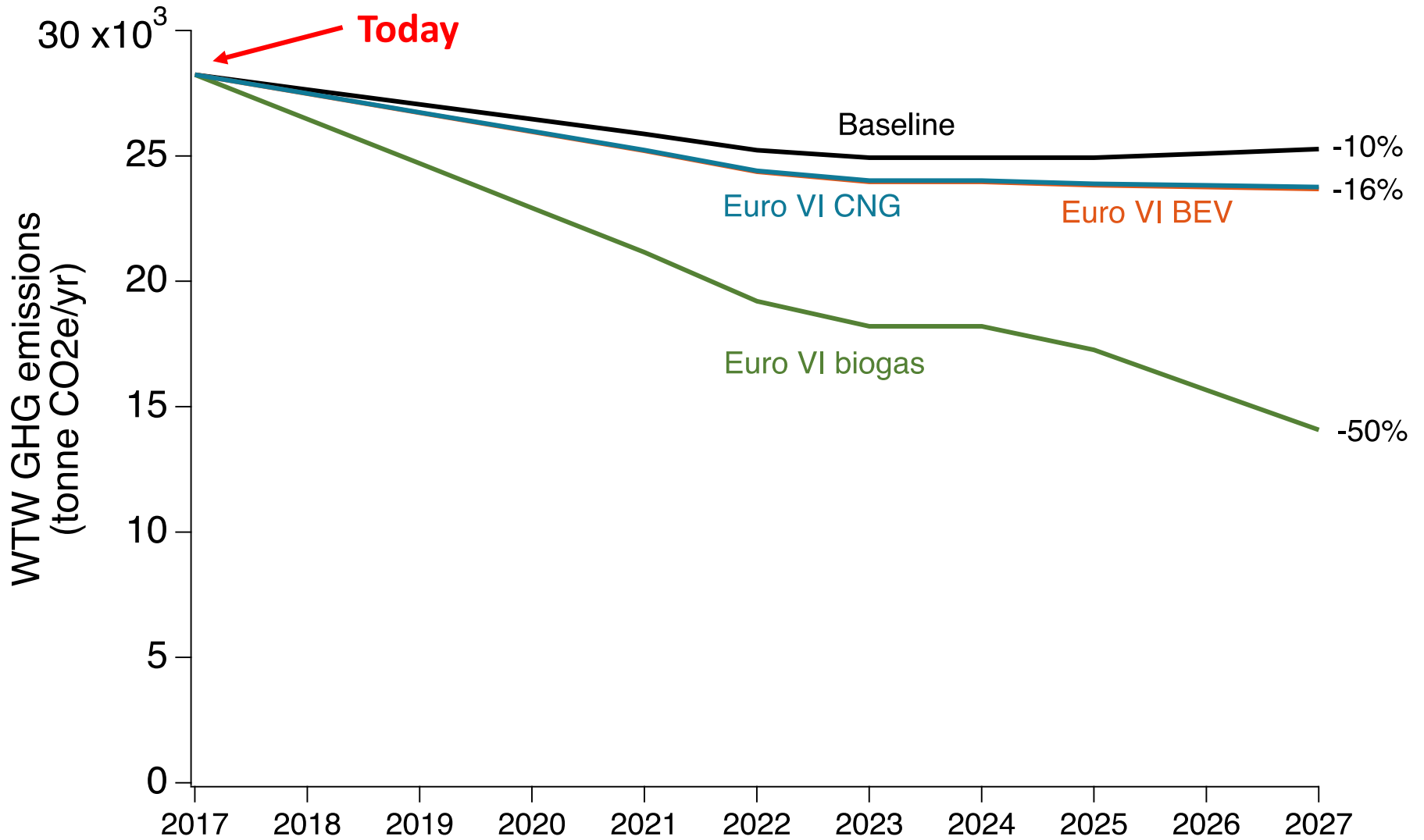
Where do we want to get to: Metrobus NOx emissions (9a)



Metrobus PM emissions (9b)



WTW greenhouse gas emissions (10)



International benchmark (11a)

- **Europe**
 - Euro VI in force since 2013, mainly diesel, CNG getting stronger, Biodiesel / ED95 in Sweden
 - Euro VI recognised as solid regulation providing lowest in-use emission performance
 - Still small number of BEV buses, hybrids share growing, tests with H2 fuel cell
 - **By 2020 diesel buses «criminalised in city centres**
 - **By 2040 – half vehicle population – electric vehicles**
- **South America**
 - Brazil is on a level similar to Euro V, discussions to go to Euro VI in 2019-2023
- **India**
 - Decided to leapfrog to Euro VI skipping Euro V in 2021 and introduce low sulfur diesel
 - Launched its electric bus
- **China**
 - Currently Euro V, moving to Euro VI in 2020 (even stricter regulation than Euro VI)
 - Leader in electric and Hydrogen Fuel Cell bus technologies
- **Indonesia**
 - Euro IV in 2021, Euro VI uncertain
- **Thailand**
 - Euro VI planned in 2026-2030
- **Mexico**
 - Euro VI planned to be introduced in 2018-2022

International benchmark - Regulation (11b)

- **Turkey:**
 - Euro VI nationwide since 2015
- **Iran:**
 - Euro VI in all major cities since 2016. Rollout started with buses. Both gas and diesel.
- **Santiago:**
 - Euro VI for Transantiago beginning in 2017. All public transit by 2019.
- **Mexico City:**
 - Euro VI in M1 fleet beginning 2017
- **Sao Paulo:**
 - proposed climate law would require zero fossil fuels in public transit by 2038.

Future technologies (12a)

• Euro VI diesel technologies

- High pressure common rail injection
- turbocharged with aftercooling, variable geometry turbocharger
- Diesel particulate filter DPF, mainly with continuous regeneration (cleaning required after 300-500'000 km)
- NOx reduction: Exhaust gas recirculation EGR, various EGR rates depending on OEM strategy
- NOx reduction: Selective catalytic reduction SCR, using AdBlue as reductant
- Electronic engine control
- Diesel fuel sulfur content <10ppm, hydrotreated vegetable oil HVO, some FAME (not all OEM's), ED95 (only 1 OEM)

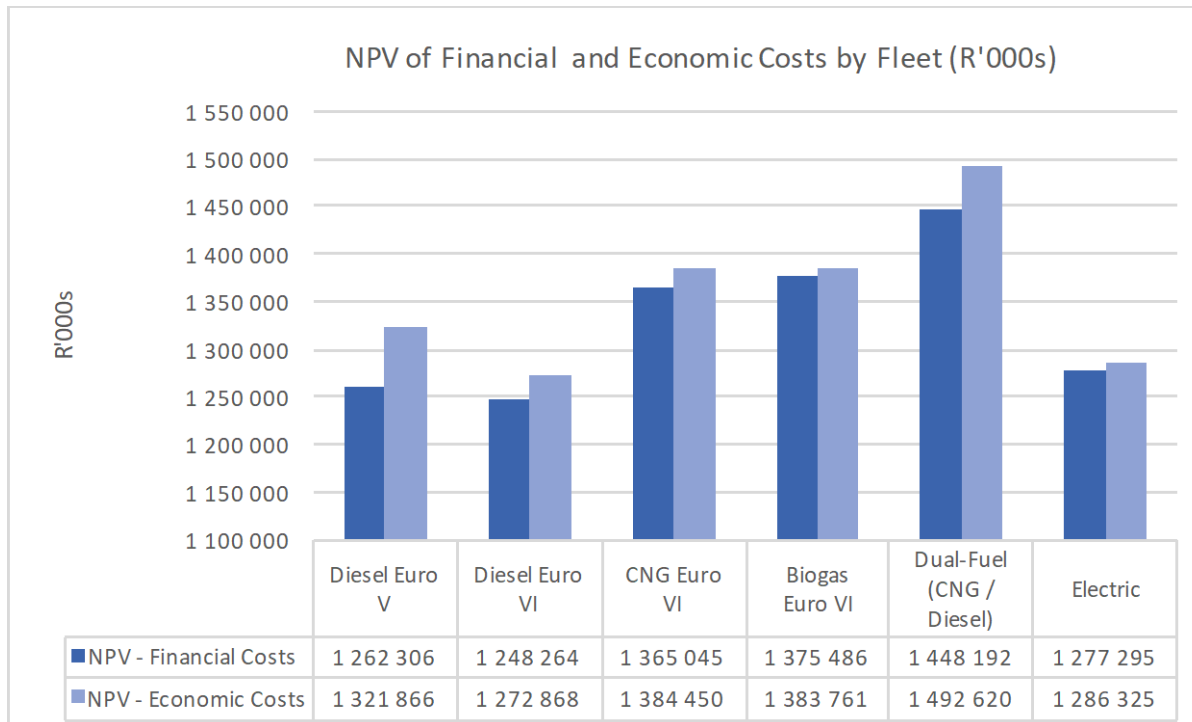
• Euro VI NG technologies

- Spark ignition
- Multipoint fuel injection (manifold)
- Stoichiometric combustion
- 3-way catalyst, lambda sensor, closed loop control
- Meeting Euro VI PN standards without filter
- Electronic engine control
- CNG or LNG fuel storage, injection in gas phase
- DDF with manifold gas injection cannot be achieved (high CH4 emission)

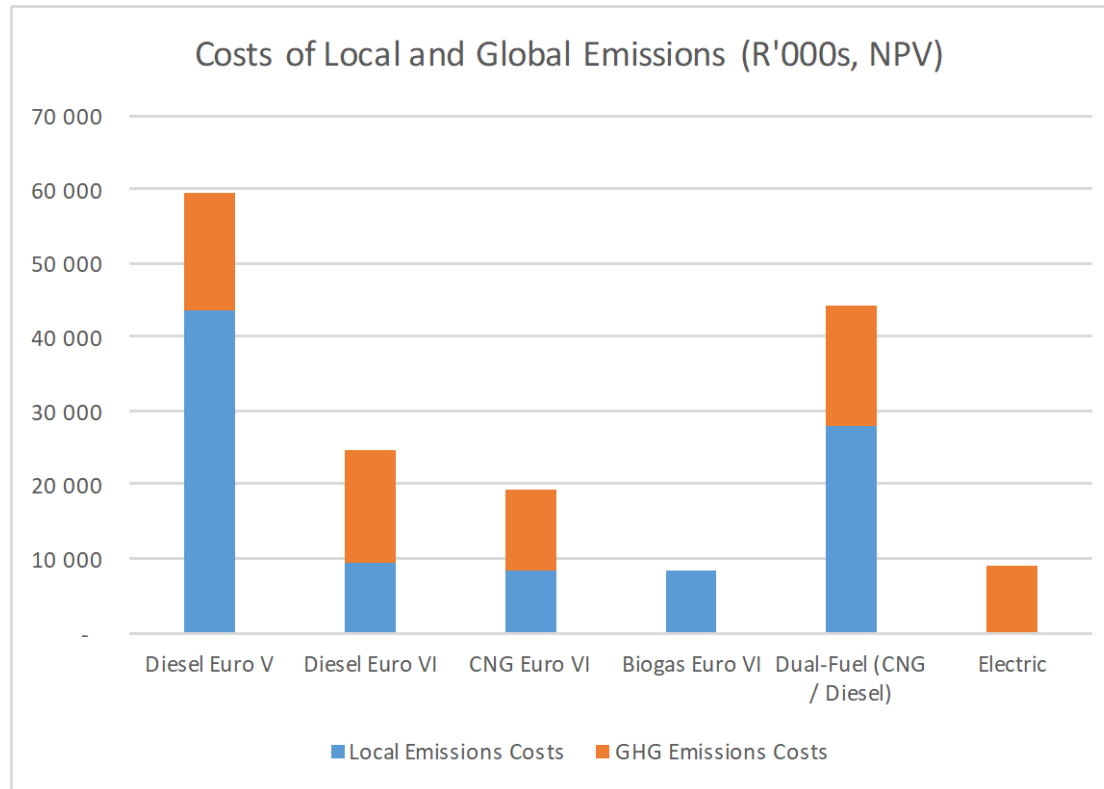
Future technologies (12b)

- **Euro VI diesel hybrid**
 - Parallel hybrid systems
 - Plug-in hybrid with extended electric range for electric inner-city operation, fast charging at endpoints of route, smaller Euro VI diesel engine
- **Trolley bus system**
 - Overhead lines throughout the route
 - Smaller diesel Euro VI diesel engine for emergency operation
- **Battery electric vehicle BEV**
 - Fully electric operation (incl. a/c)
 - Size of battery pack defines range of vehicle
 - Bus heating may be difficult
- **H2 fuel cell**
 - No large scale operation so far
 - Battery pack to balance between fuel cell output and power requirement
 - Future potential should not be neglected, all depending on fuel cell cost

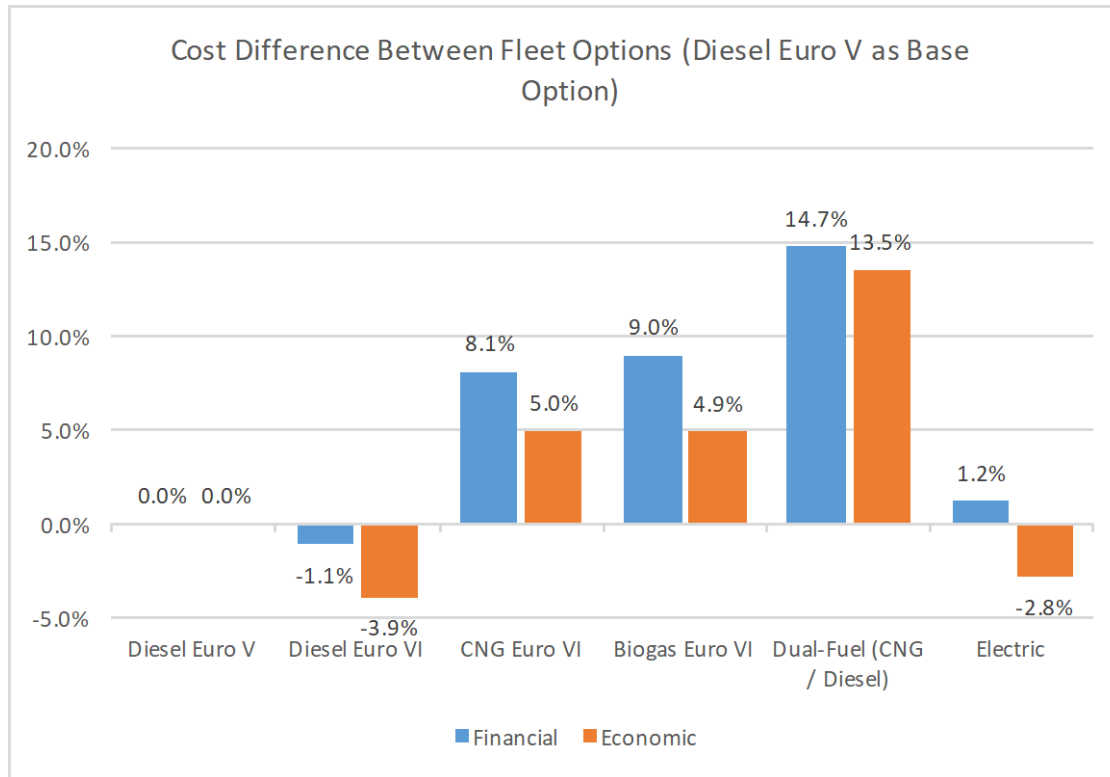
Bus Options Comparison (13a)



Bus Options Comparison (13b)



Bus Options Comparison (13c)



Way Forward en route

- Electric Bus Near term Feasibility Study - 2019
- Electric Bus Pilot Implementation – 2023

- Consultations:
 - Sanedi
 - IDC
 - USAID SALED

Thank You !

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