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Take the bus towards sustainable mobility in 2050

Clean and sustainable public transport buses

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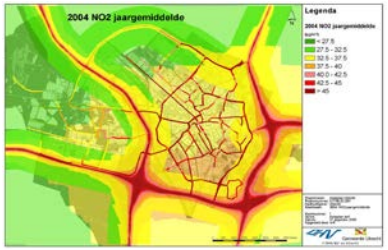
Sustainable Buses
What for?

local / regional



Air quality

Noise

Less traffic jam

global

Climate

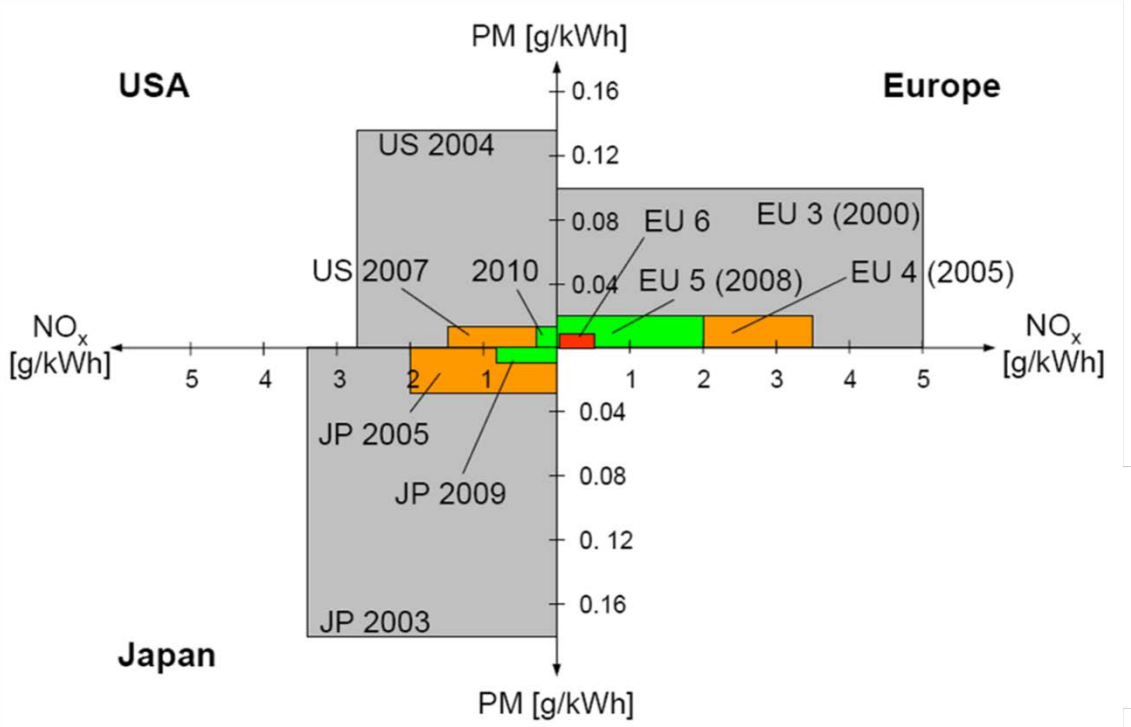
Energy availability

Local
Focus on air quality (short term)

- Many large cities in Europe do not fulfil European air quality standards
  - Especially 40 µg/m^3 requirement of NO_2
- Zero-emission vehicles can contribute significantly:
  - Introduction in larger numbers (< 2015)
  - Focus on urban area
  - Replacement of (older) diesel vehicles
  - Travel a significant amount of kilometres within city centres
- Mid term: zero-emission vehicles still attractive
  - Depending on development of future European air quality standards
    - For example: new indicator for ultrafine particles ($PM_{0,1}$ or EC)

Air quality

Emission standards for Heavy Duty vehicles



- Current Euro V or EEV do not guarantee low Real World Emissions:
  - Euro V NO_x emission limit: 2 g/kWh,
    Real Word NO_x emissions: **1 - 15** g/km !

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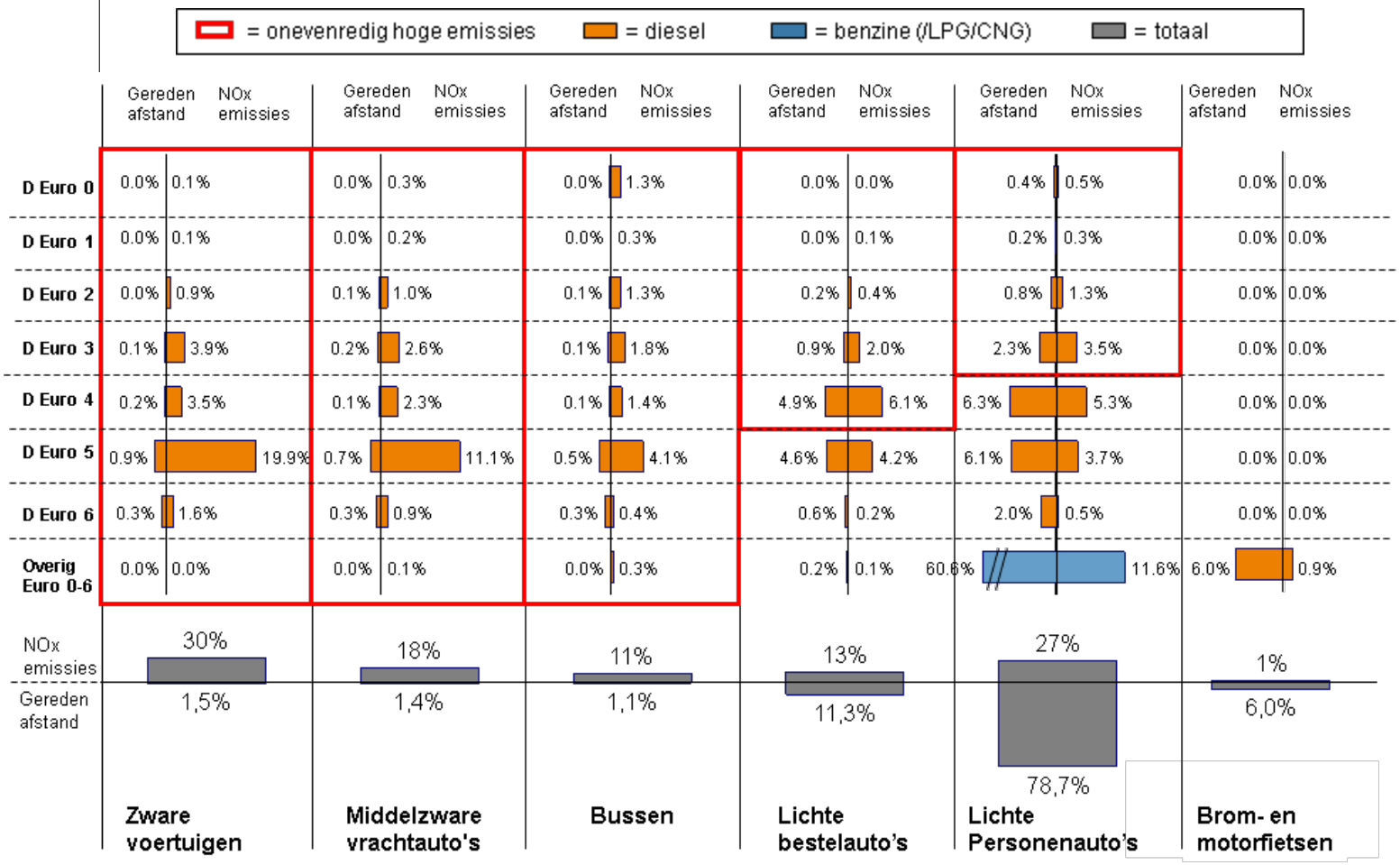
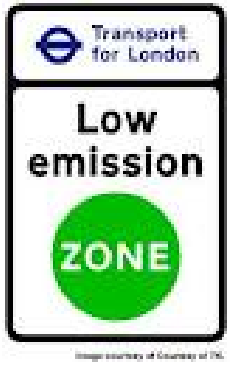
In 2015 in Dutch cities 74% of traffic NOx emissions are emitted by 14% of the vehicle kilometres



- And **a large share** of it by **logistics and buses**

Local
Effects of “severe” measures are limited

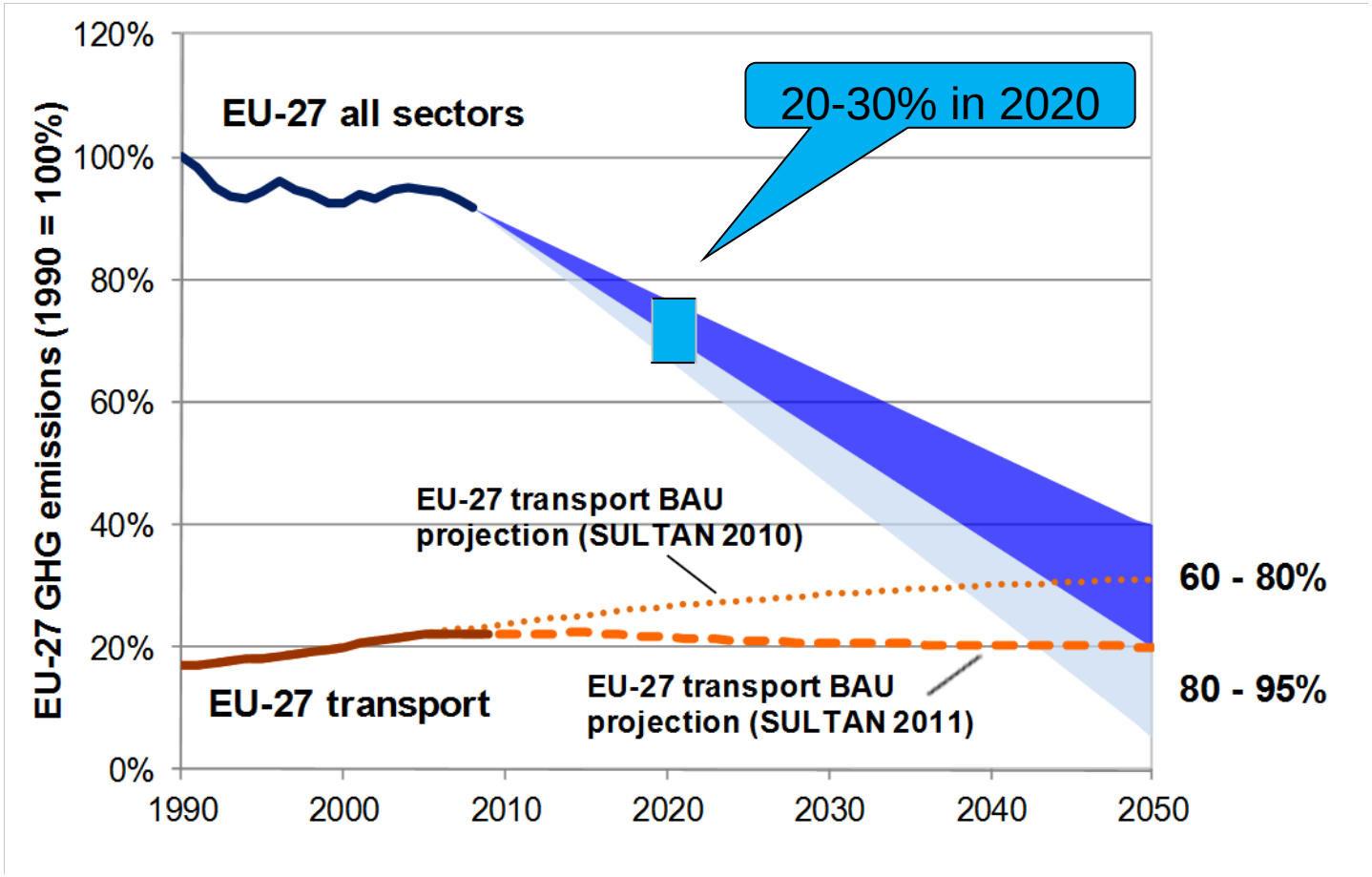
- Typical measures ad their effects on NO_2 in 2015
  - General (larger area):
    - Environmental zone for trucks ~ 0.2 - 0.3 µg/m^3
    - Environmental zone for vans ~ 0.2 - 0.3 µg/m^3
    - Less congestion ~ 0.1 - 0.2 µg/m^3
  - Measures on specific locations (**hotspots**):
    - **Clean buses** ~ **a few µg/m^3**
      - Prins Hendrikkade, Amsterdam: 3000 buses/day
        - vervanging van 40% van merendeels EEV bussen leidt tot 3 µg/m^3 reductie
      - Nobelstraat, Utrecht: 1500 buses/day



European level

EU white paper: CO2 reduction target for transport 60% (1990)

Bron: GHG 2050 II, 2012



European level

Focus on long term CO_2 reduction, buses ?

WHITE PAPER - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system

- *"Halve the use of 'conventionally-fuelled' cars in urban transport by 2030; phase them out in cities by 2050; achieve essentially CO_2-free city logistics in major urban centres by 2030"*

Main message:

1) To realise CO_2 targets, conventional fuelled vehicles need to be phased out
2) Urban buses ….are well suited for early introduction of new technologies

- ***Promote joint public procurement for low emission vehicles*** *in commercial fleets (delivery vans, taxis, buses…)."*
- *"The gradual phasing out of 'conventionally-fuelled' vehicles from the urban environment is a major contribution to significant reduction of oil dependence, greenhouse gas emissions and local air and noise pollution. It will have to be complemented by the development of appropriate fuelling/charging infrastructure for new vehicles."*

Transition proces

Backcasting: start transition at right time (now)

2050

- **In 2050 the vehicle fleet must contain a large share of efficient vehicles on sustainable energy carriers**

2030

- **Large scale introduction of sustainable options**

2012

- **Between Now and 2030**:
  - Conventional vehicles can & must become more fuel efficient
  - Test and select feasible options and development to technical and economical succesfull products
  - Create environment for introduction
    - Policy, infrastructure, production of sustainable energy

Sustainable buses
Options

- New technologies are, especially at the start, quite expensive
- Reliablity & costs are uncertain
  - Testing fase required → before large scale introduction
- Two very important questions:
  - Which *technology* is most cost efficient for *what application*?
  - How to create a context that motivates *manufacturers* and *users* to invest in these new technologies?

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Sustainable buses

Options

What option most suitable for your application

- **Battery-Electric**
  - Local zero emission
  - Limited range
  - Relatively expensive vehicles
  - Charging: conductive / inductive / battery change
- **Hybrid**
  - Local zero emission in short range
  - Plug-in+bigger battery increase zero-emission range
  - Easy implementation in fleet management
  - Range not limited: regional use possible
  - Vehicles cheaper than battery-electric
- **Fuel cell + H_2**
  - Zero emission
  - Range not limited
  - WTW CO_2 higher than battery-electric
- **Bio fuels**
  - No or limited local emission benefit
  - Limited WTW advantages liquid biofuels
  - Biogas most sustainable, limited resources


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Sustainable buses
Introducing sustainable buses

- Selecting one option ? or … experimenting ?
  - Purchasing large volumes, reducing price
  - But specific applications (trip length etc) require specific solutions
  - Still have a lot to learn….
- Smart concession required
  - Return on investment on vehicles and infrastructure
  - New business models (infrastructure & buses not in concession)
  - Clean buses on air quality hotspots
  - Requirements on vehicle level g/km instead g/kWh on engine level
- Prepare your choise well, know what to buy
  - Investigate specific application of buses (trip length etc..)
  - Understand technology and costs (vehicle + energy + infrastructure)
  - Collect ***objective*** information regarding vehicles (testing + sim.)

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Sustainable buses: be critical ! Test, simulate, specify requirements !

Example: Performance test procedure for electric buses

- Energy consumption and range
- 50% payload
- Using SORT drive cycles
  - SORT 1 heavy urban
  - SORT 2 easy urban
  - SORT 3 suburban
- Energy consumption monitor

Sustainable buses
Conclusions

- **Sustainable buses** are a small volume group of vehicles suitable for **linking short term environmental advantages** to **long term technology transition**
- Short term advantages require **fast introduction**
- Important to create possibilities for fast and stable development
  - Adjusting / optimizing concession requirements
- Selecting is important, but testing various technologies as well:
  - Develop and share knowledge
  - Coordination between local pilots / plans
- Prepare pilots well
  - Select most suitable technology for specific application
  - Monitor pilots carefully
- Local governments are crucial !