NewcastleGateshead Low Emission Zone Feasibility Study

Dr Paul Goodman

Dr Anil Namdeo, Dr Fabio Galatioto, Prof Margaret C Bell (Newcastle University)

Edwin Foster (Newcastle City Council)

Caroline Shield (Gateshead Council)

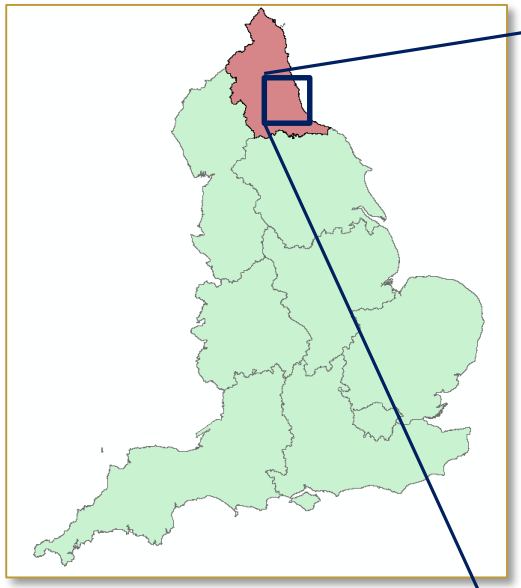
16th International Conference on Harmonisation within Atmospheric Dispersion Modelling for regulatory Purposes, Varna, Bulgaria, 10th September 2014

Transport Operations Research Group

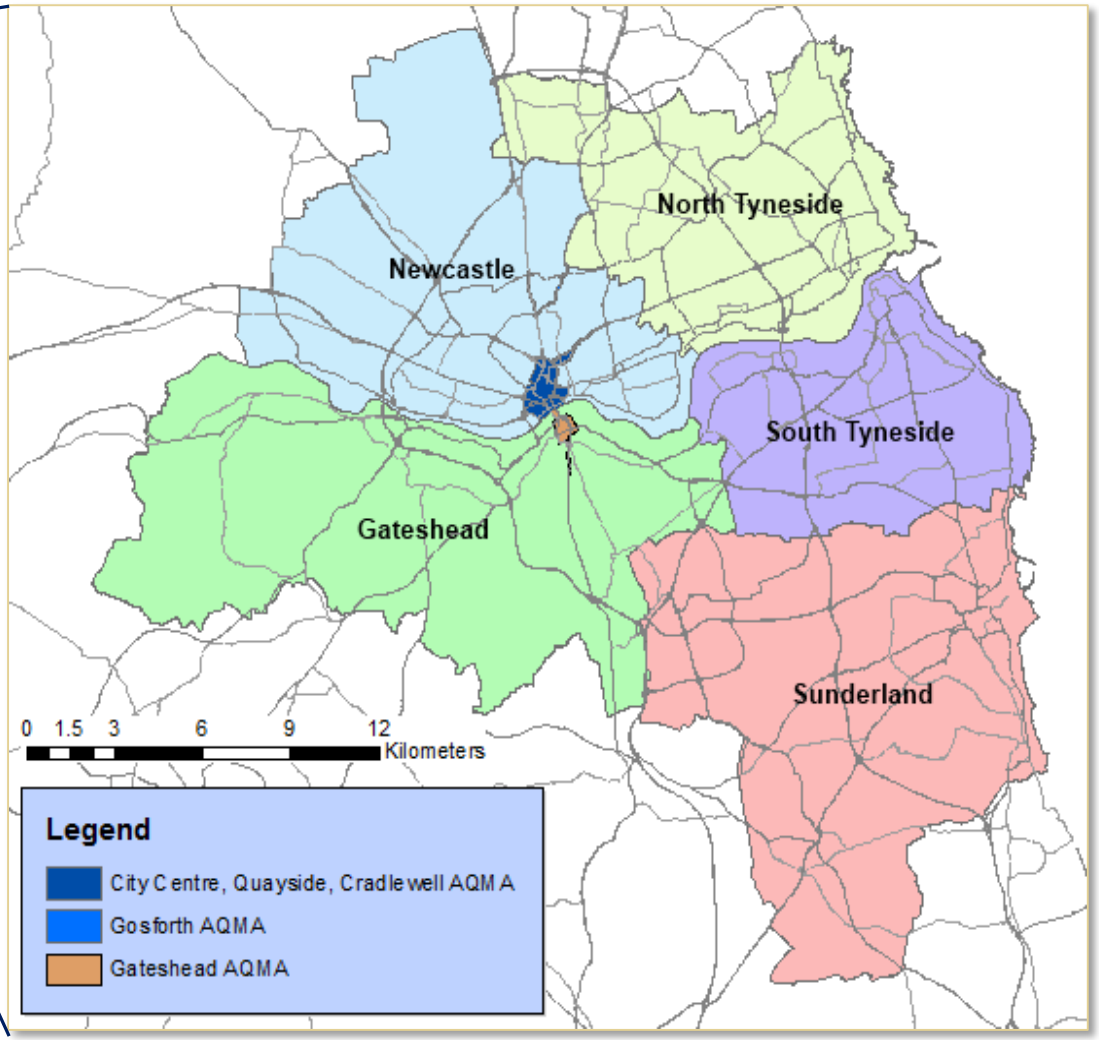
School of Civil Engineering and Geosciences

Newcastle University, UK

Modelling Domains



Tyne and Wear within England

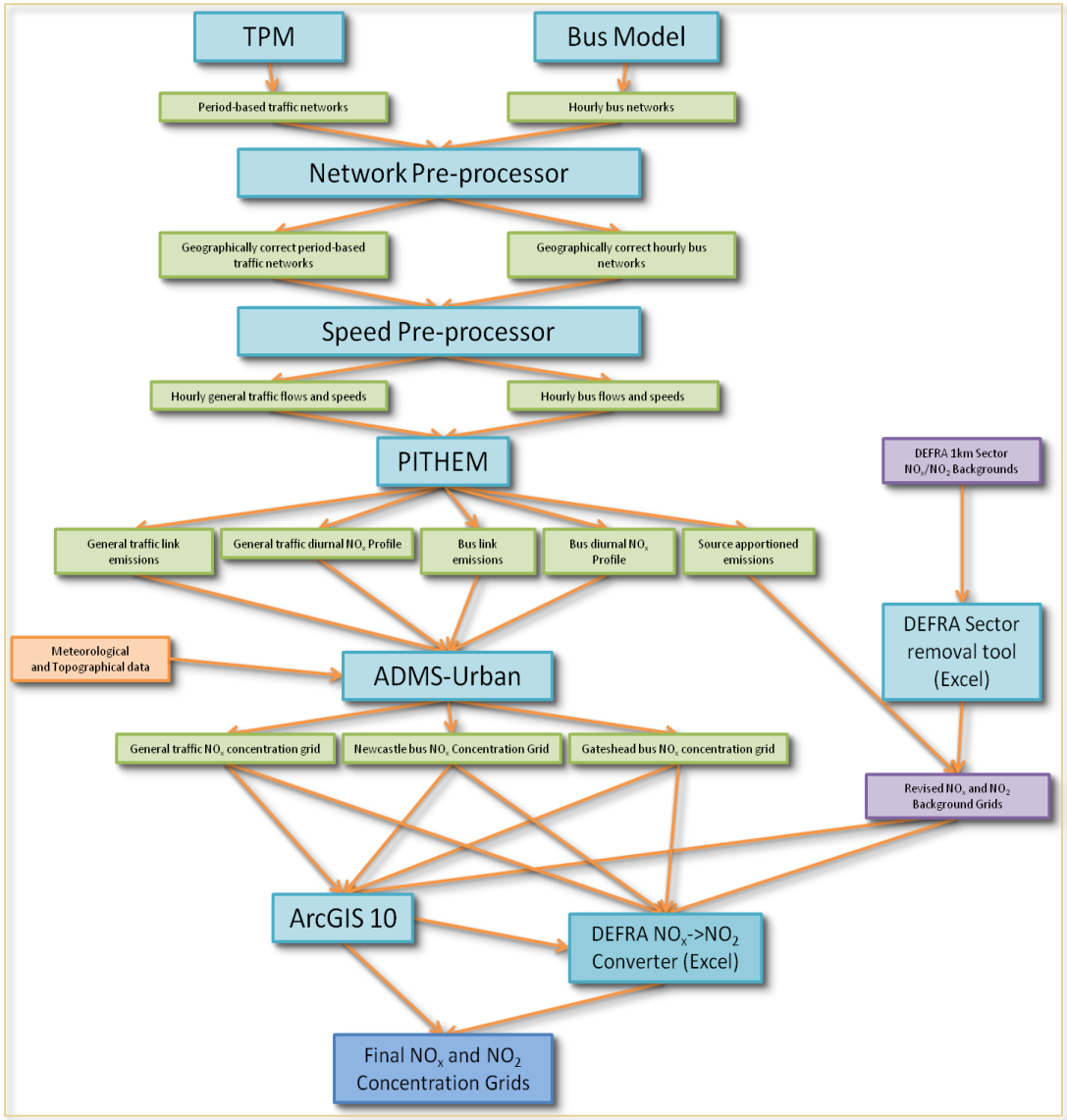


NewcastleGateshead within Tyne and Wear

NewcastleGateshead LEZ Feasibility Study

- Work funded by DEFRA (Department for the Environment, Food and Rural Affairs) Air Quality Grant Scheme.
- AQMAs in Newcastle Centre, Gateshead and Gosforth to the north of Newcastle Centre : ***Nitrogen Dioxide is the key concern.***
- Modelling covered combined Newcastle and Gateshead area.
- Based on strategic Tyne and Wear Transport Planning Model (TPM 3.1) + separate database of bus routes and timetables.
- Emissions for scenarios modelled in Newcastle Universities' PITHEM software, then exported to ADMS-Urban.
- Scenarios run for base year of 2010 and a future year of 2021.
- LEZ presumed to affect the whole urban area, and be active on all days.

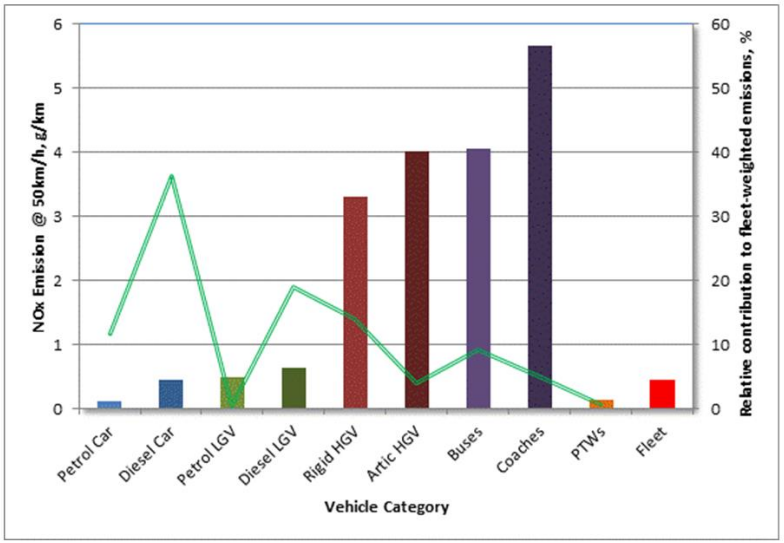
Modelling Structure



- Based of TPM v3.1
- Altered flows (detector data)
- Separate Public Transport data
- Separate speed data
- OS MasterMap ITN Geometry

- PITHEM -> UK DEFRA EFT 5 -> Emissions
- ADMS-Urban -> Dispersion
- UK DEFRA spread sheets -> Backgrounds and NO_x to NO_2
- ArcGIS -> Processing

Fleet-weighted NO_x Emissions



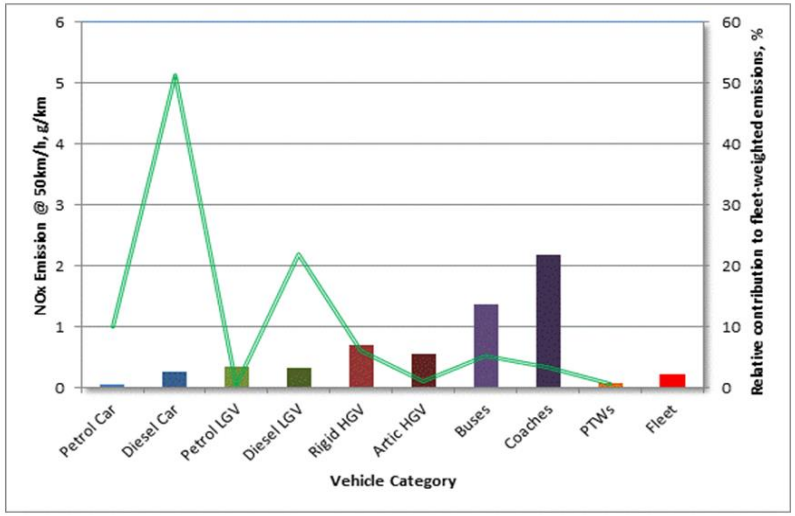
Comparative NO_x emission rates at 50km/h for vehicles in the English Urban Fleet for 2013 (using EFTv5.2c, DEFRA, 2013)

Urban fleet 2013 NO_x emissions:

- Columns = vehicle emissions rates in g/km
- Green line = %-age contribution of that vehicle type to the overall fleet-weighted emission

Urban fleet 2020 NO_x emissions:

- Note fall in emissions rates, except powered two-wheelers (PTW)
- Note increase in relative contribution from diesel cars



: Comparative NO_x emission rates at 50km/h for vehicles in the English Urban Fleet for 2020 (using EFTv5.2c, DEFRA, 2013)

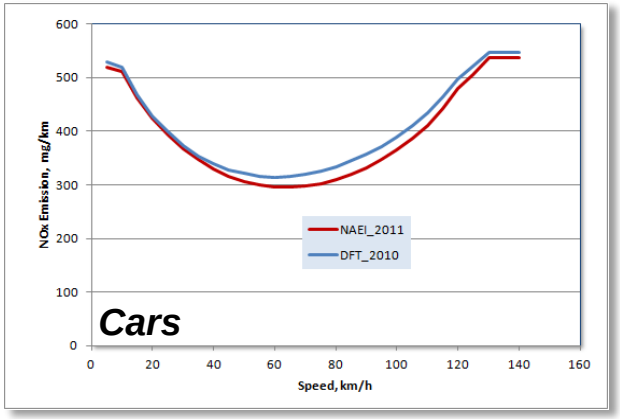
Newcastle University · Newcastle City Council · Gateshead Council · torg

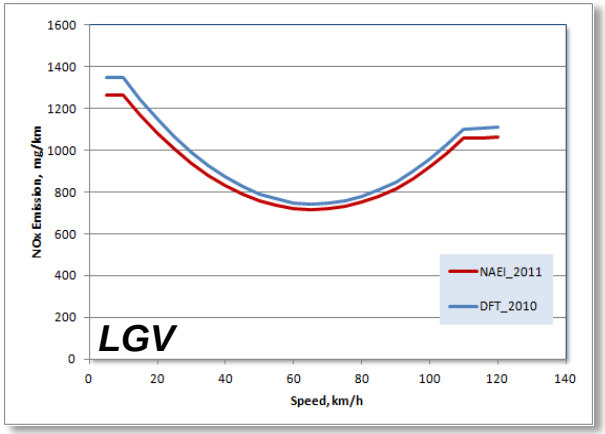
NewcastleGateshead Specific Fleets

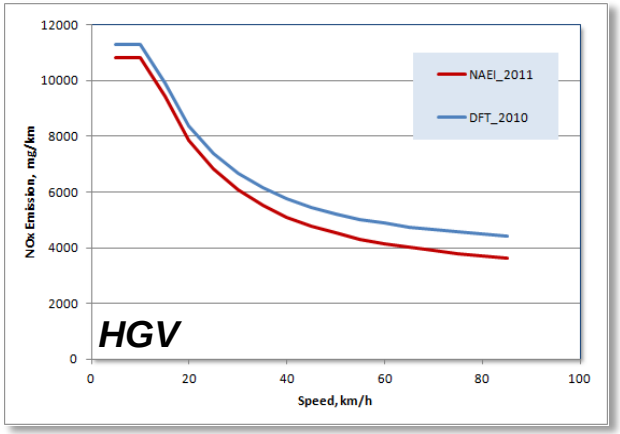
- 4 User classes (cars, LGV, HGV, buses)
- 5 Pollutants (uCO_2, NO_x/primary NO_2, PM_{10}, $PM_{2.5}$)

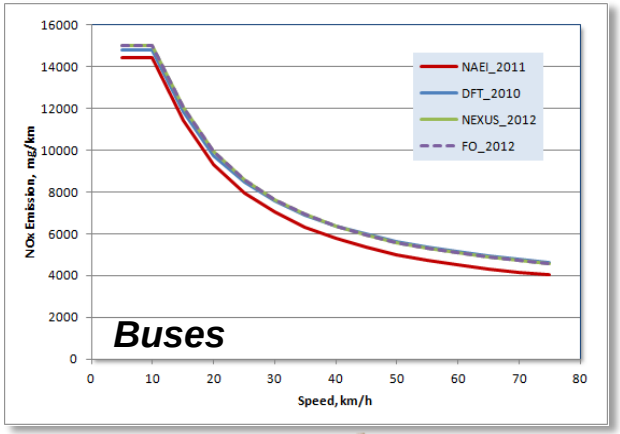
2010 NO_x emission curves:

- Emissions factors calculated from:
  - NAEI base years
  - DfT year of first registration data
  - Information provided by bus operators
  - ANPR data not used (available mid-project)
  - Vehicle numbers not scaled to vehicle kilometres



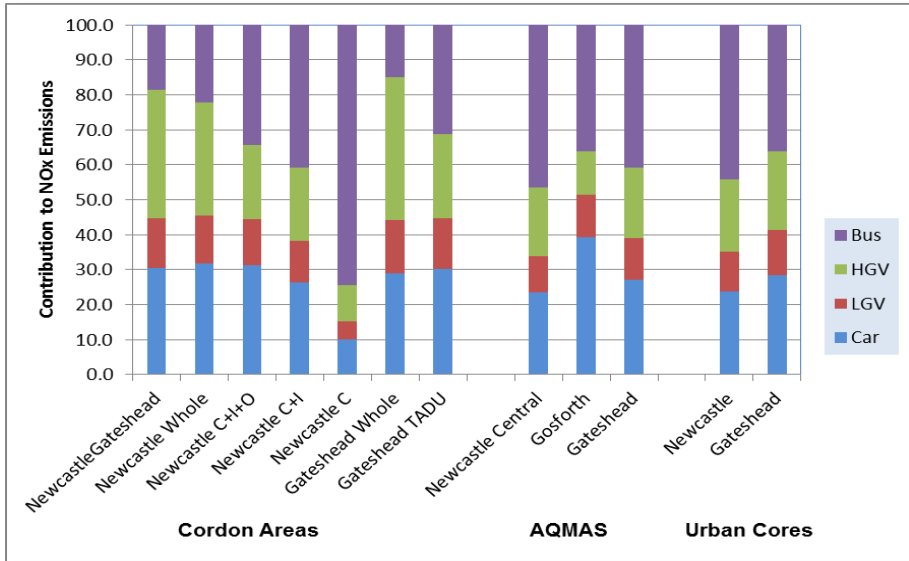


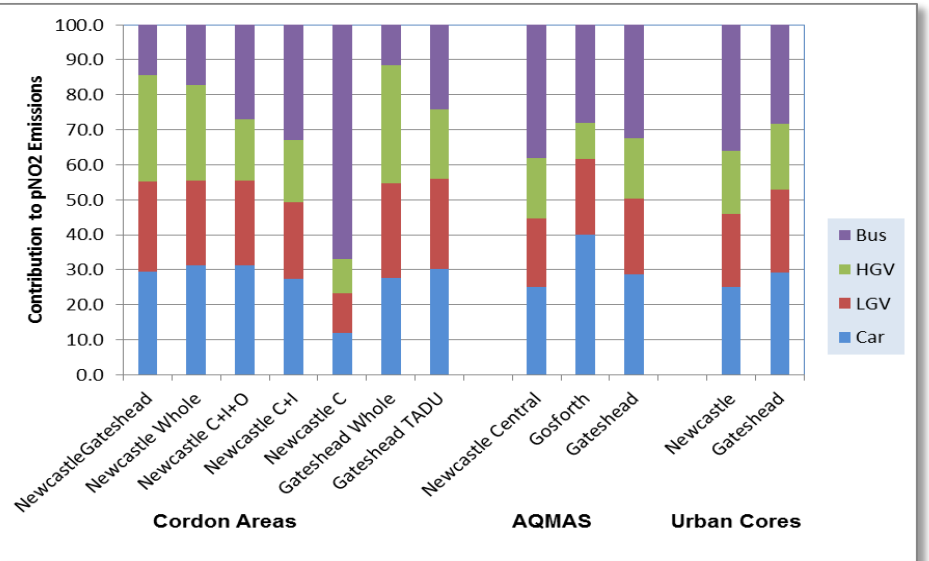


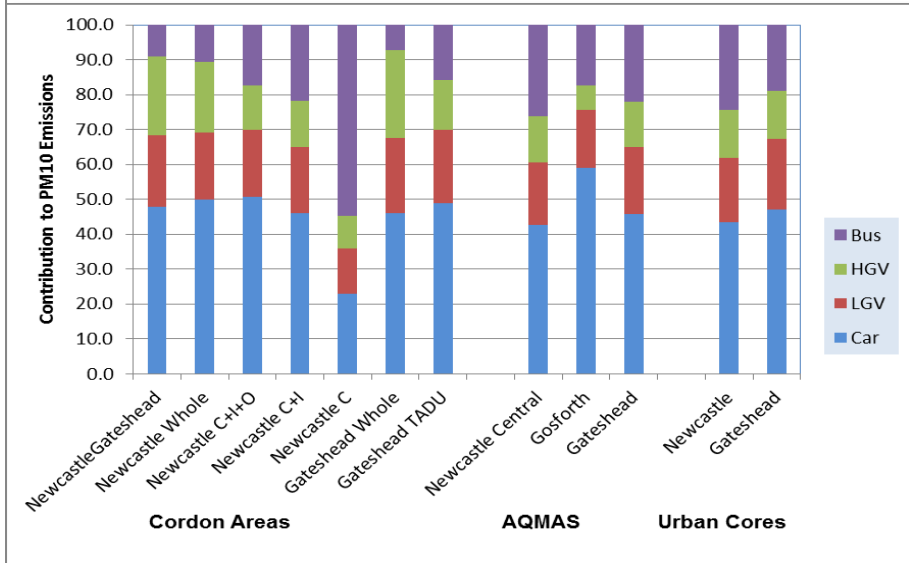


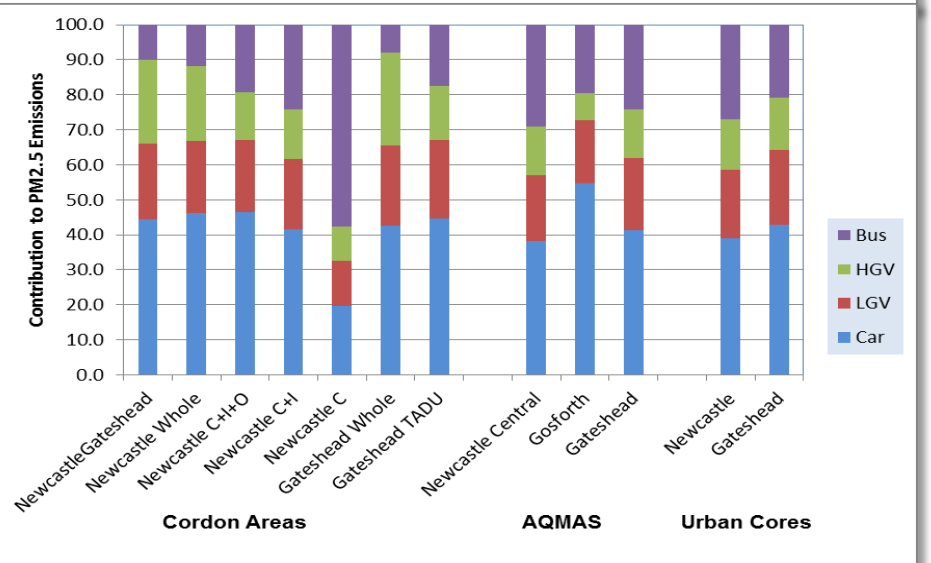
Newcastle University
Newcastle City Council
Gateshead Council
torg

Baseline 2010 Source Apportionment







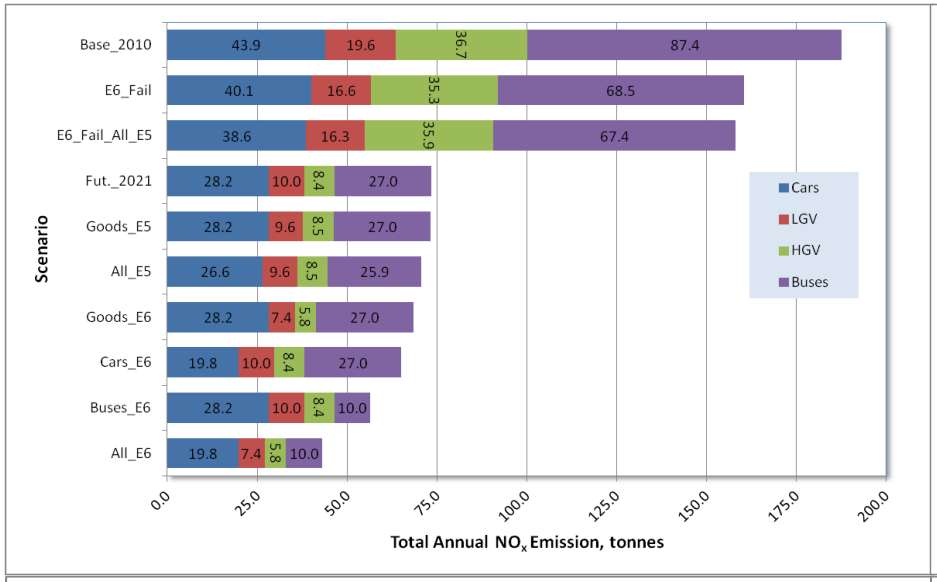


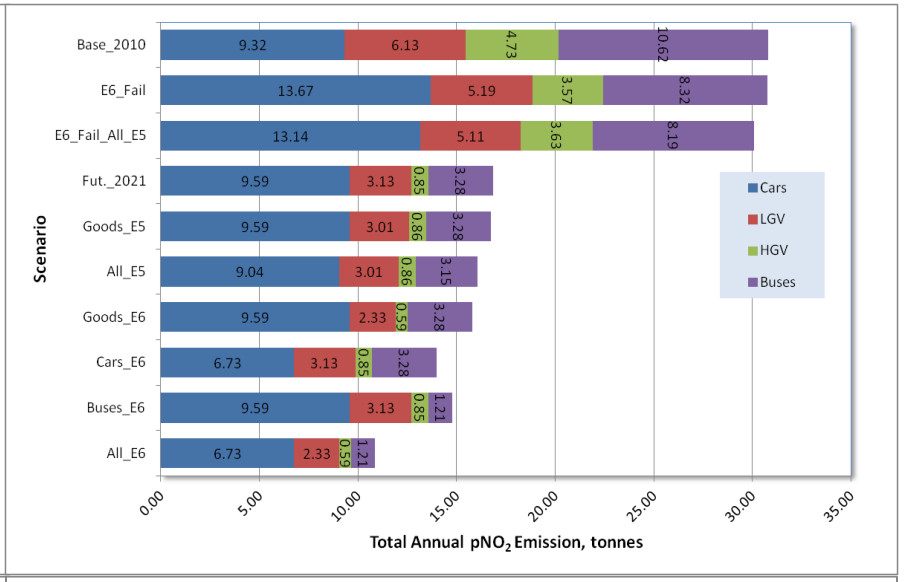
Newcastle University
Newcastle City Council
Gateshead Council

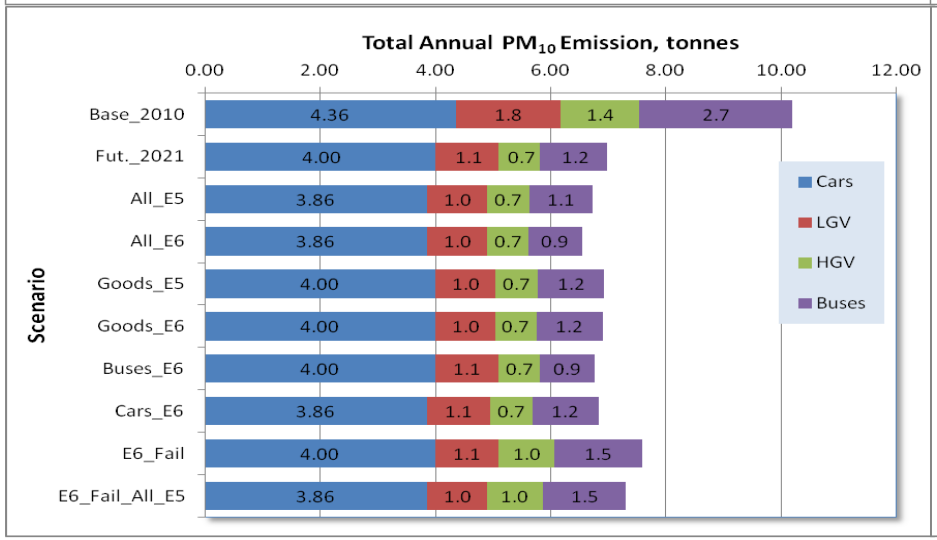
LEZ Options – Tested Scenarios

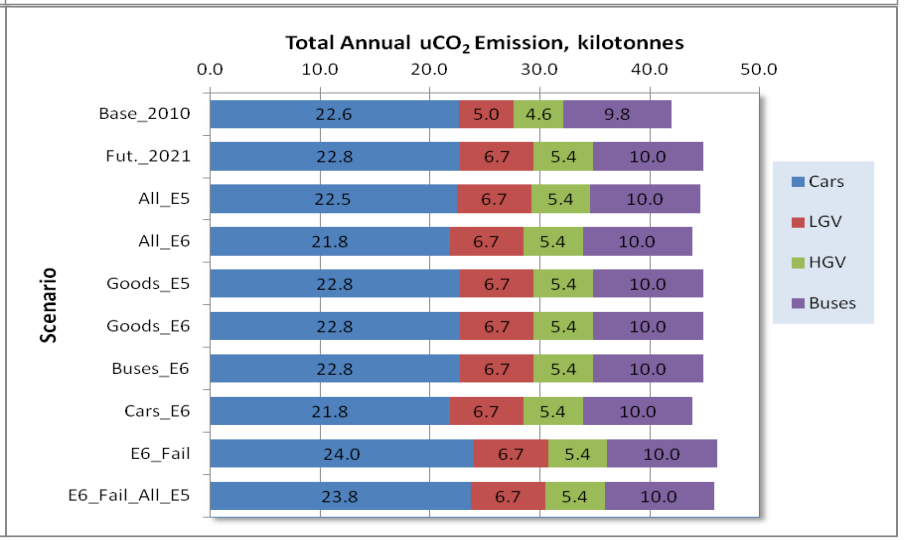
- **Future year 2021 'Business and Usual' (BAU) scenario** – using the NAEI 2021 fleets for all vehicle classes;
- **LEZ scenario 1** – all vehicle classes are assumed Euro 5/V compliant;
- **LEZ scenario 2** – all vehicle classes are assumed Euro 6/VI compliant;
- **LEZ scenario 3** – all goods vehicles (i.e. petrol LGVs, diesel LGVs, rigid HGVs, articulated HGVs) are assumed Euro 5 compliant;
- **LEZ scenario 4** – as above, but all goods vehicles are assumed Euro 6 compliant;
- **LEZ scenario 5** – all buses are assumed Euro VI compliant;
- **LEZ scenario 6** – all passenger cars (petrol car, diesel car) are assumed Euro 6 compliant.
- **Future year 2021 BAU scenario 2** - ***Euro 6 failure*** – all vehicles that were Euro 6/VI compliant in scenario 1 above are assumed to be 5/V only;
- **LEZ scenario 7** - As 8 above, but all vehicles comply with a minimum of Euro 5/V.

Sample Scenario Results – Newcastle Centre



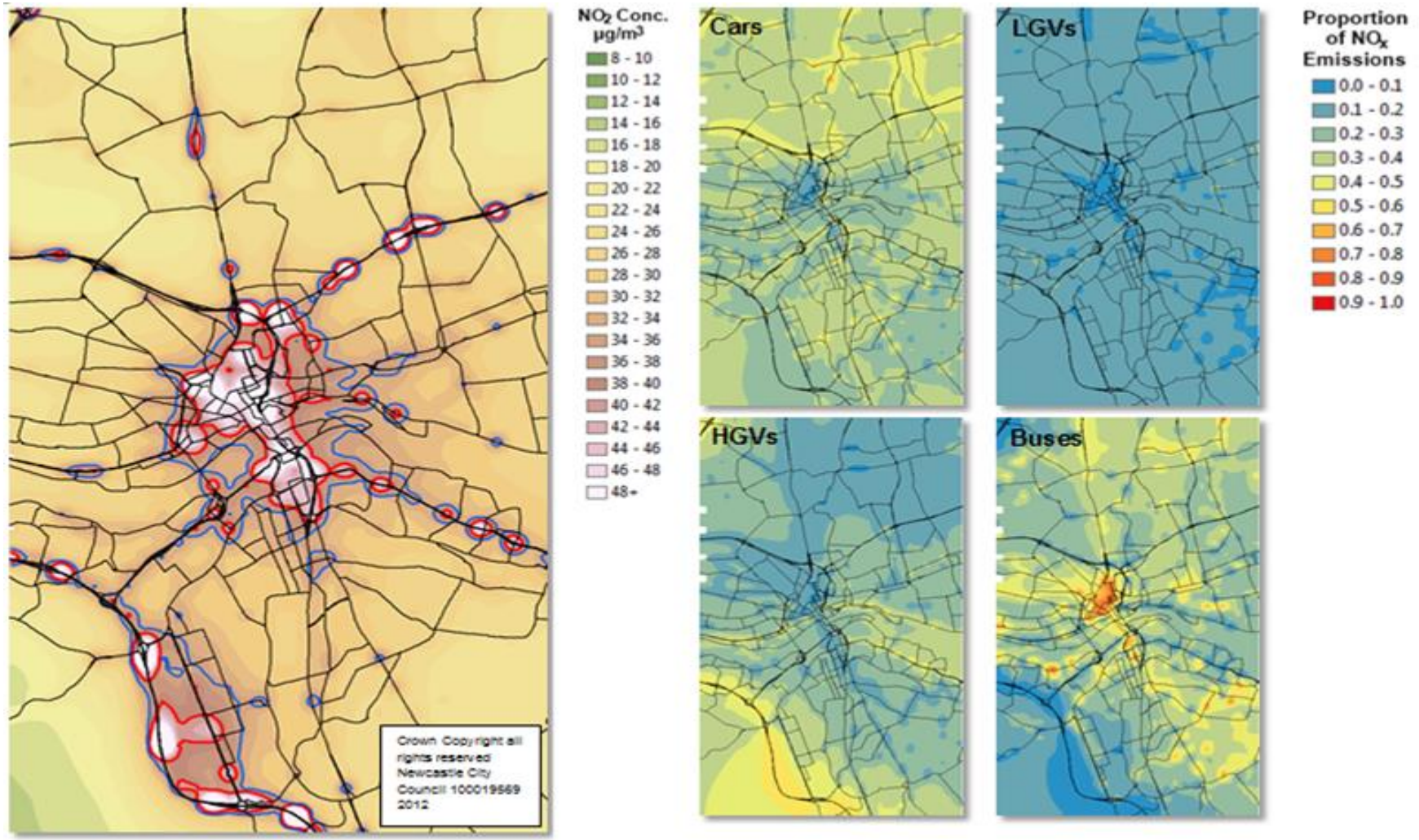






Newcastle University
Newcastle City Council
Gateshead Council
torg

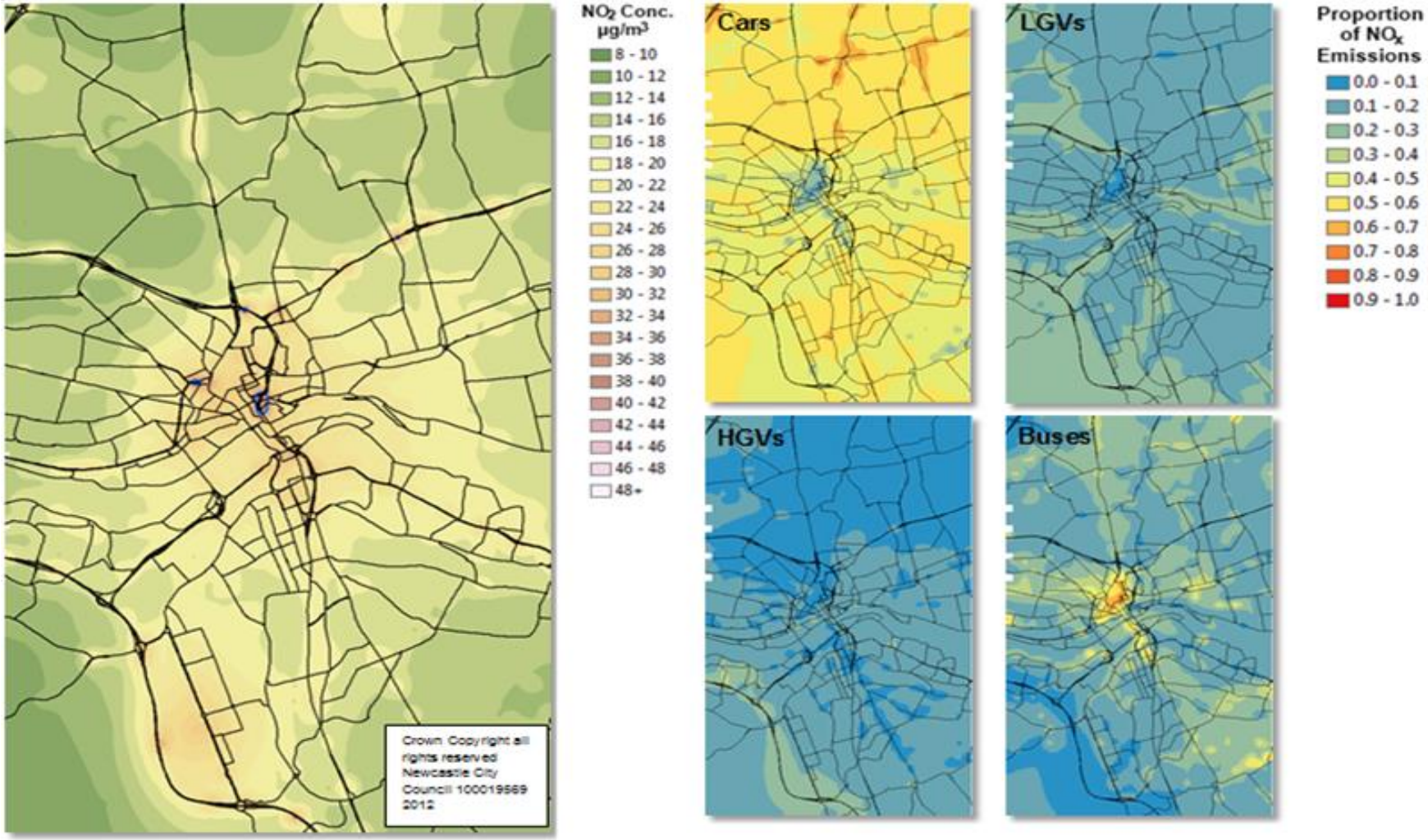
Base 2010 Results



Base 2010 Scenario: Annual Hourly Mean NO_2 Concentrations (Left) [All concentrations in µg/m³. Red contour = 40 µg/m³, Blue contour = 35 µg/m³] and proportion of total NO_x contribution from vehicle classes (Right).

Newcastle University · Newcastle City Council · Gateshead Council · torg

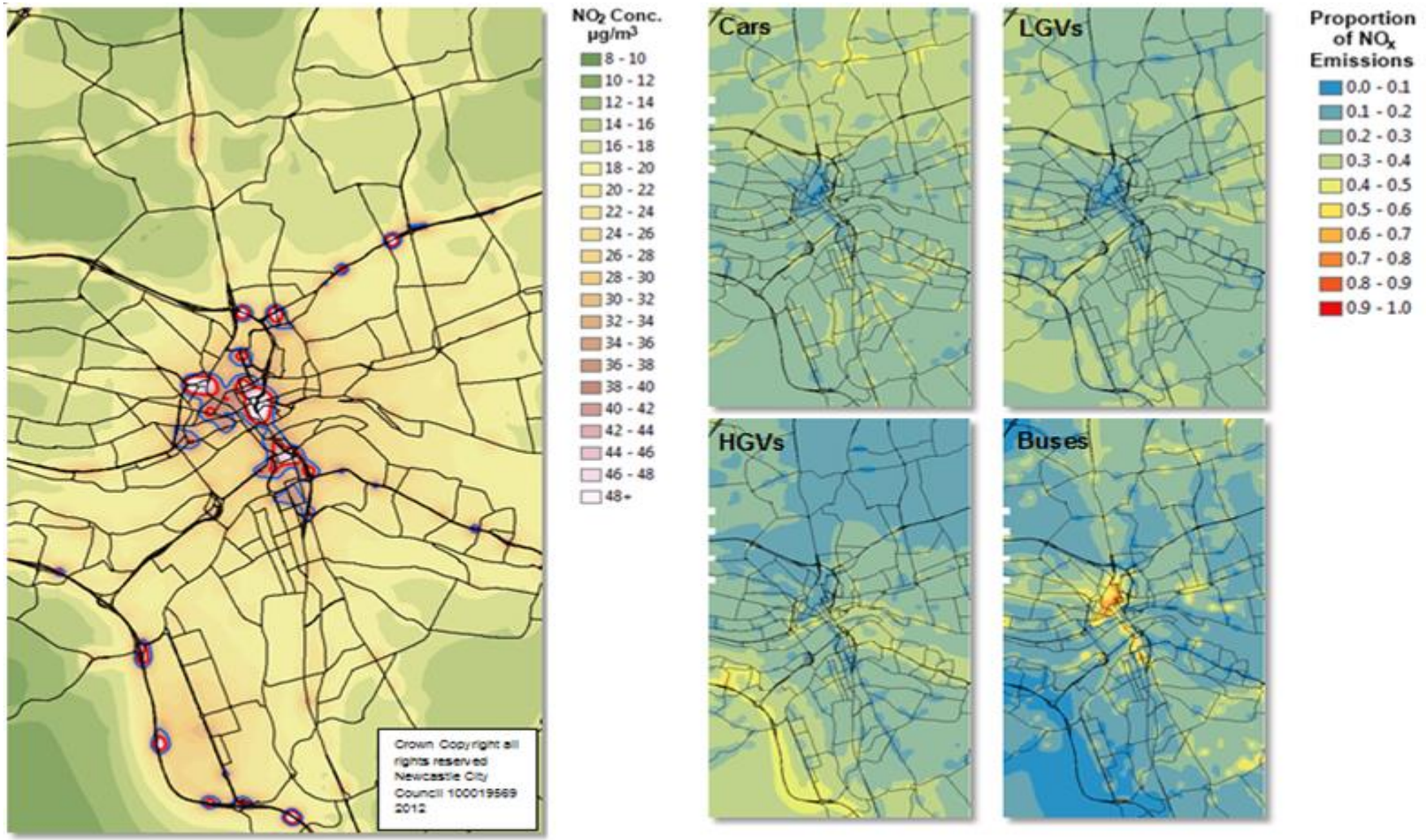
BAU 2021 Results



'Business as Usual' Scenario, NAEI/EFT5.1.3 Fleet: Annual Hourly Mean NO_2 Concentrations (Left) [All concentrations in µg/m³, Blue contour = 35 µg/m³] and proportion of total NO_x contribution from vehicle classes (Right).

Newcastle University · Newcastle City Council · Gateshead Council · torg

What if…? 2021 results



LEZ 2021 Scenario 7, All vehicles EURO 5/V Compliant, EURO 6/VI Failure: Annual Hourly Mean NO_2 Concentrations (Left) [All concentrations in µg/m³. Red contour = 40 µg/m³, Blue contour = 35 µg/m³] and proportion of total NO_x contribution from vehicle classes (Right).

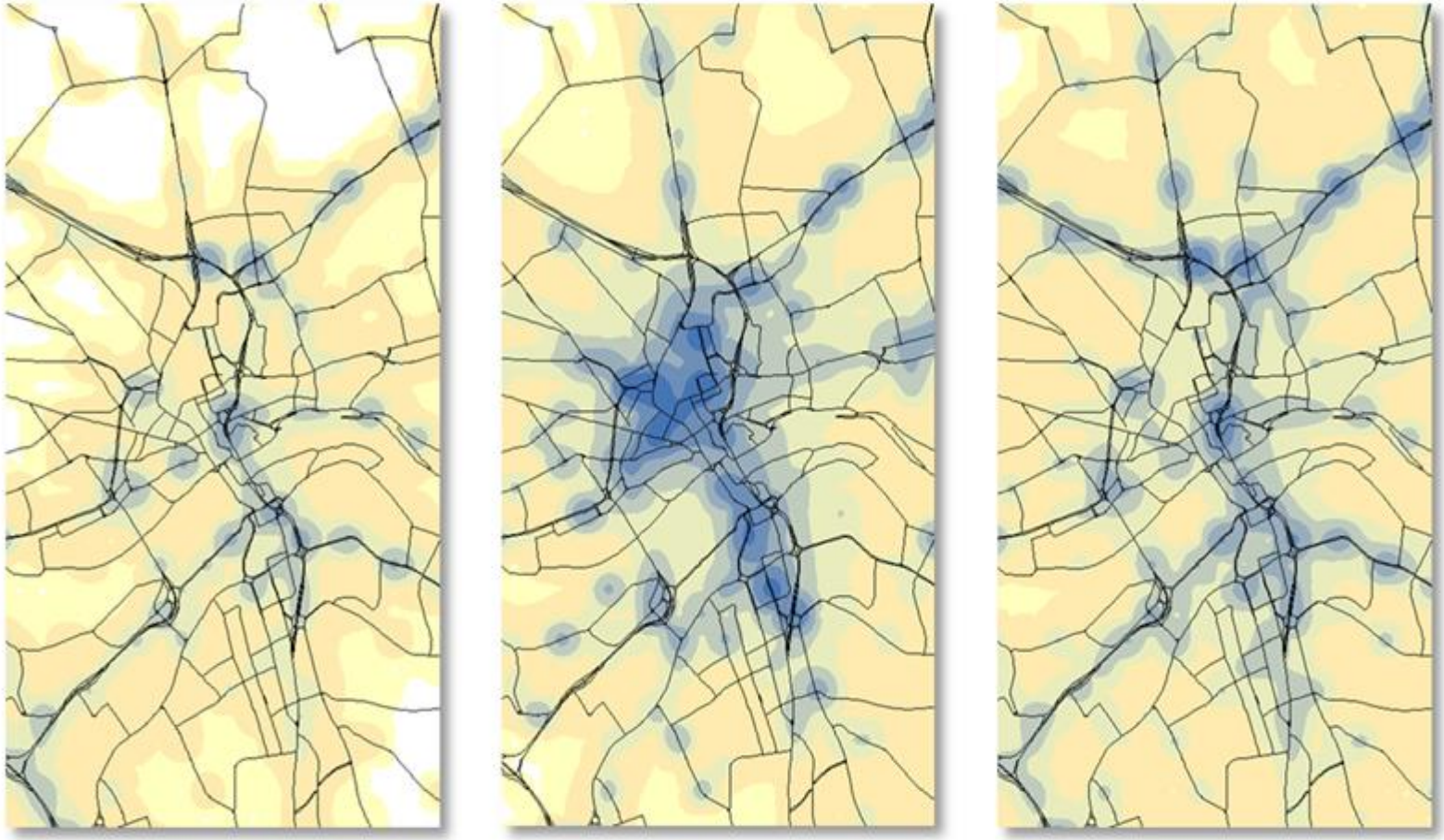
Newcastle University · Newcastle City Council · Gateshead Council · torg

Euro 6 LEZ NO_2 Difference Maps

LGV & HGV Euro 6/VI

Buses Euro VI

Cars Euro 6



Difference maps for NO_2 concentrations between the 'All goods Euro 6' (left), 'All Buses Euro 6' (centre) and 'All cars Euro 6' (right) and the baseline 2021 scenario.

Newcastle University · Newcastle City Council · Gateshead Council · torg

Limitations

- Transport Modelling
  - Separate PT and general traffic models – consistency between the two?
  - Validation of PT model – some bus flows appear high and on non-existent routes?
  - Traffic growth out to 2021? Impact on speed based on Volume-to-Capacity (V/C) ratio

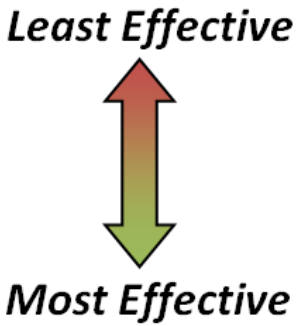
- Emissions modelling
  - Assumes DEFRA UK Emissions Factors (v5.1.3) is correct!
  - Effects of congestion?
  - Effectiveness of Euro 5/V and 6/VI?
  - Penetration of Euro 6/VI into Tyne and Wear fleet?
  - 2021 scenario too far into the future?

- Dispersion modelling
  - Low resolution (200m x 200m with interpolation)
  - Choice of background level
  - Limitations of NO_x to NO_2 conversion methodology
  - Particulates too high in DEFRA background maps, compared to monitored data

Conclusions

- Rank order of LEZ options:

  - All goods vehicles Euro 5/V;
  - All vehicle classes Euro 5/V;
  - All goods vehicles Euro VI;
  - All cars Euro 6;
  - All buses Euro VI;
  - All vehicles Euro 6/VI.



- 'Best' option covering the entire city centre only made on average a 2µg/m^3 difference to NO_2 in the City Centre, compared to approx. 15µg/m^3 from general fleet (+other) improvements.
- Euro 5/V options could actually make the situation worse over the 2021 BAU.
- If Euro 6/VI fails to deliver could still get exceedences in central areas
- Intermediate years? 2021 quite a late time horizon? Strategic model appropriate?
- Hybrid and retrofit bus options?

Contacts

Dr Anil Namdeo

Senior Lecturer in Transport and Sustainability

- Email: anil.namdeo@ncl.ac.uk
- Telephone: +44 (0) 191 222 8486
- Fax: +44 (0) 191 222 6502
- Address: School of Civil Engineering and Geosciences
  Transport Operations Research Group (TORG)
  Room 2.24
  Cassie Building
  Newcastle University
  Newcastle upon Tyne
  NE1 7RU

Dr Paul Goodman

Researcher in Transport and the Environment

- Email: paul.goodman@ncl.ac.uk
- Telephone: +44 (0) 191 222 5945
- Fax: +44 (0) 191 222 6502
- Address: School of Civil Engineering and Geosciences
  Room 2.22
  Cassie Building
  Newcastle University
  Newcastle upon Tyne
  NE1 7RU
  UK