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School of Civil Engineering & Geosciences

JCT Conference 2013

Professor Margaret Bell CBE

40 years of tORG

Abstract

In the quest of driving down carbon dioxide with new engine and fuel technologies the impacts on air quality have not always been beneficial, particularly for nitrogen dioxide. This presentation will provide estimates of the changes in carbon emissions over the period 1998 to 2012 based on a congestion sensitive emissions algorithm and the use of SCOOT data in Leicester network. In addition a comprehensive analysis of the precision in the air quality management area in the city Centre of Newcastle will be used to illustrate how the duration of air quality events as well as their magnitude have increased over the decade from 2001. Thus, the issues and conflicts in trying to deliver policies that address both climate change and air quality impacts will be presented.

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Just how are we doing with managing air quality and delivering carbon targets?

Professor Margaret Bell CBE
Transport Operations Research Group
School of Civil Engineering and Geosciences
Newcastle University

19th -20th September 2013.

JCT Conference, University of Warwick

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This presentation

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- Policy
- Carbon Emissions: How are we Doing?
- Air Quality: How are we Doing?
- Can Public Transport Deliver win-win for carbon and air quality?
- Magnitude of the Challenge
- NUIDAP-Role in Environment Management
- Summary
- Some Actions
- Final Comment

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Policy

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- **BINDING TARGETS**: Reduce **CO_2 emissions** by 67% of 2010 values by 2050 (Committee on Climate Change 2010)

- Air Quality: Despite emissions standards nitrogen dioxide levels continue to rise and UK face fines levied by EU.

- Health Impacts: 50,000 deaths brought forward in 2010 due to poor air quality

- Accidents: In UK 1870 fatal accidents in 2010

- Congestion: Major source emissions, destroying planet, reducing life expectancy and damaging the economy

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Carbon Emissions: How are we doing?

This research is currently being prepared for publication therefore confidential

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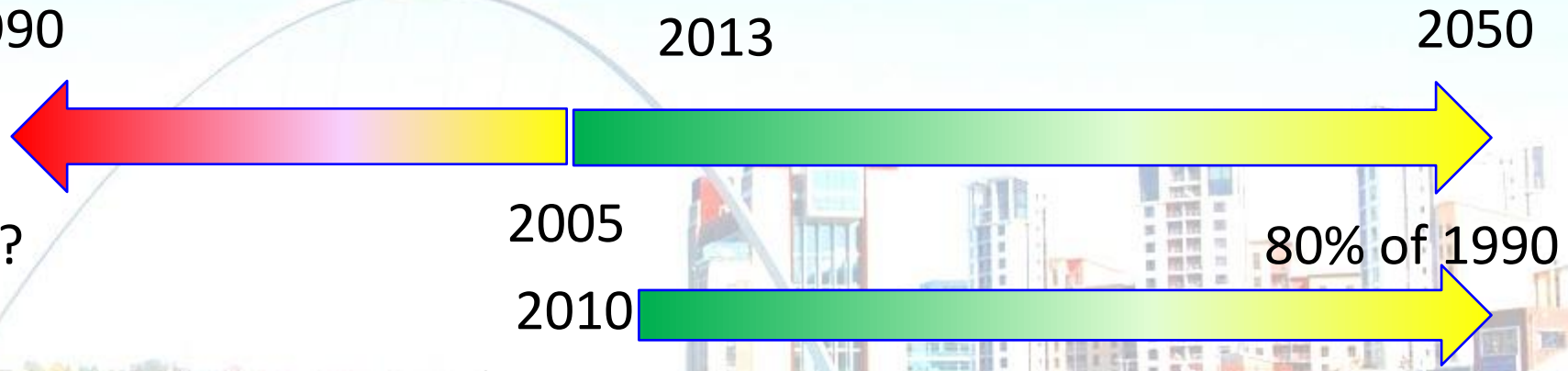
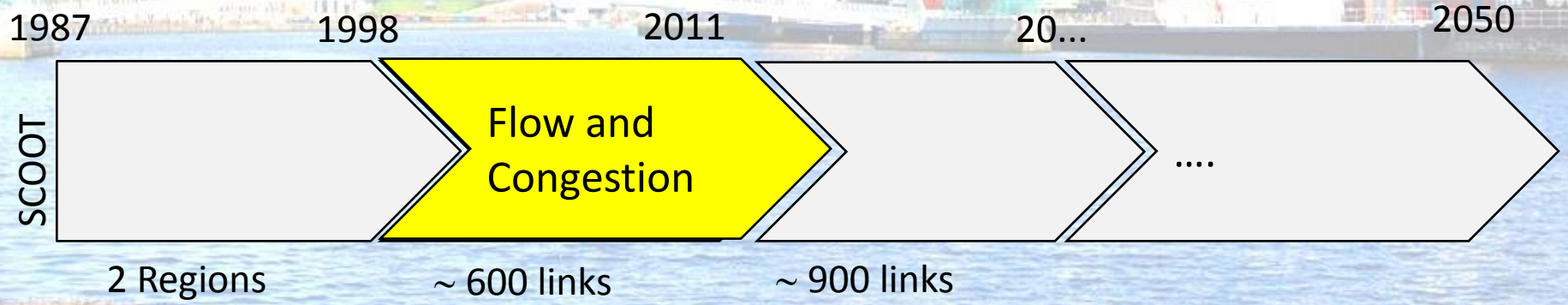
Carbon Emissions
How are we doing?



Leicester SCOOT database

67% of 1990



Model change in UK Fleet emissions over time

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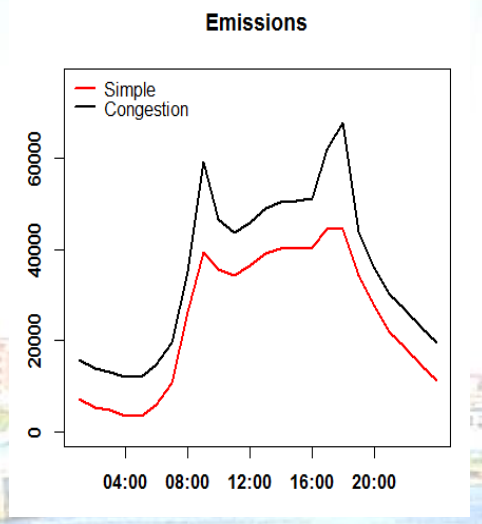
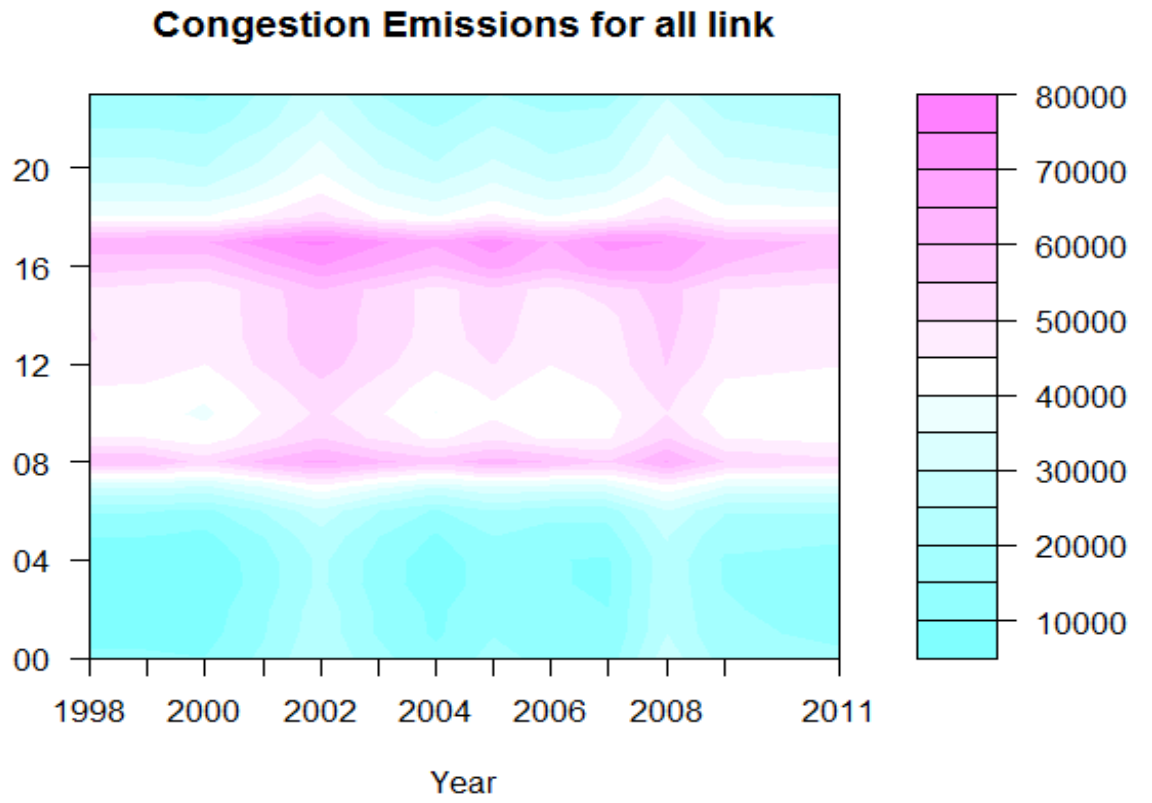
Carbon Emissions 1998-2011





- Traditional emission models - **reduction** in 2008 of about 10% over 1998
- Complex congestion related emission model - **increase** of about 3% over 1998 data
- After the recession the complex congestion related emission model – recession fall of 5% over 1998.

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Tailpipe Emissions data analysis has been published in:

Rhys-Tyler GA, Legassick W, Bell MC. The significance of vehicle emissions standards for levels of exhaust pollution from light vehicles in an urban area. *Atmospheric Environment* 2011, **45**(19), 3286-3293.

Rhys-Tyler G.A. and Bell M.C. (2012). Toward reconciling instantaneous roadside measurements of light duty vehicle exhaust emissions with type approval driving cycles. Environmental Science & Technology, 46(19), 10532-10538. http://pubs.acs.org/doi/abs/10.1021/es3006817

To view the full paper see http://pubs.acs.org/articlesonrequest/AOR-Dwwp8izvGJF8vx9TY7y5 (registration required).

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Fuels and Engine Technologies

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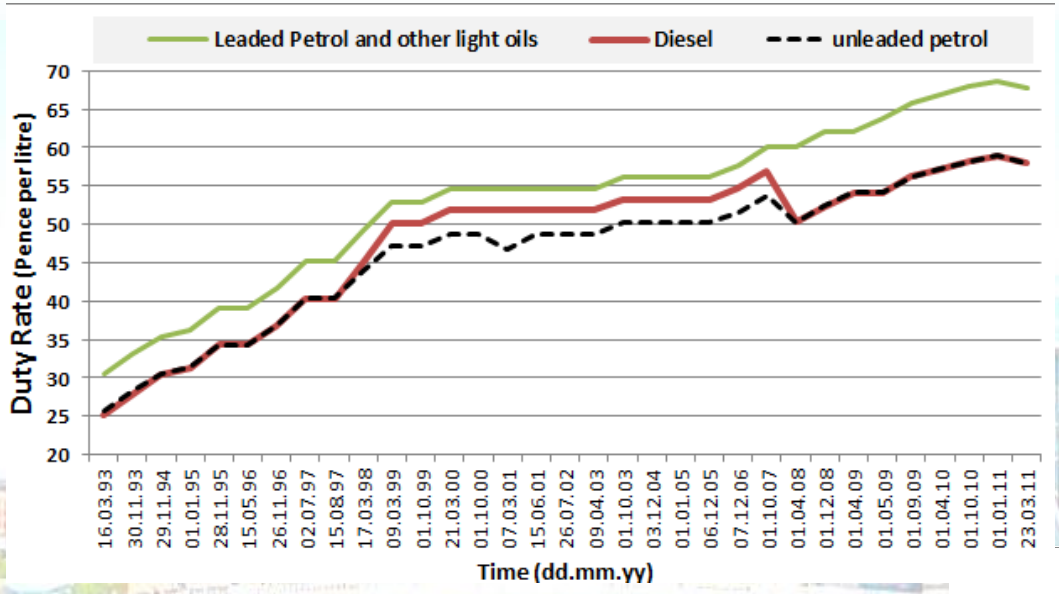
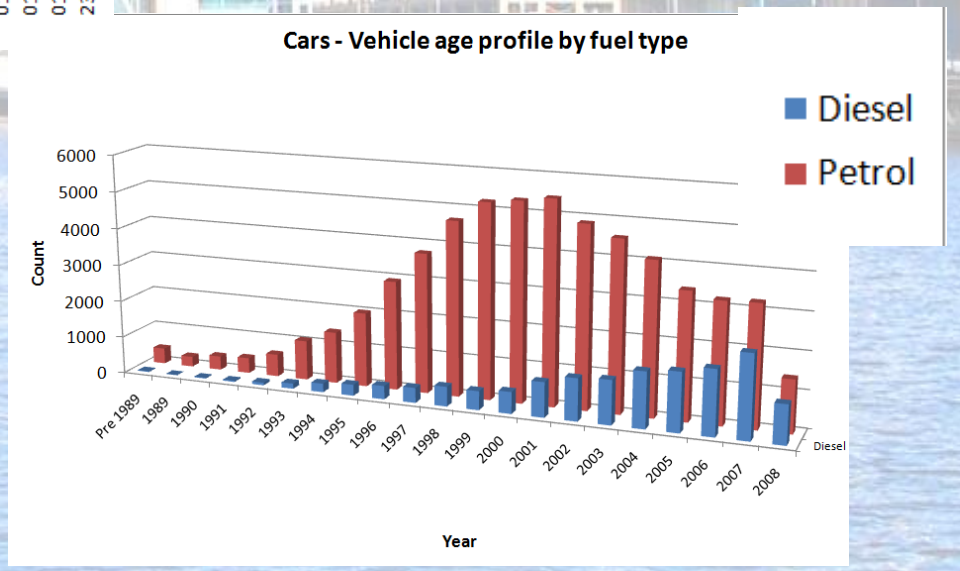


Increase number and proportion of diesel/petrol vehicles on the road

More mpg from diesel compared to petrol. UK Government incentives to buy diesel - Therefore less CO_2

Car manufacturer's continued efforts making engines more efficient to reduce CO_2 and NO



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Engine Technologies

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Rhys-Tyler GA, Legassick W, Bell MC (2011).

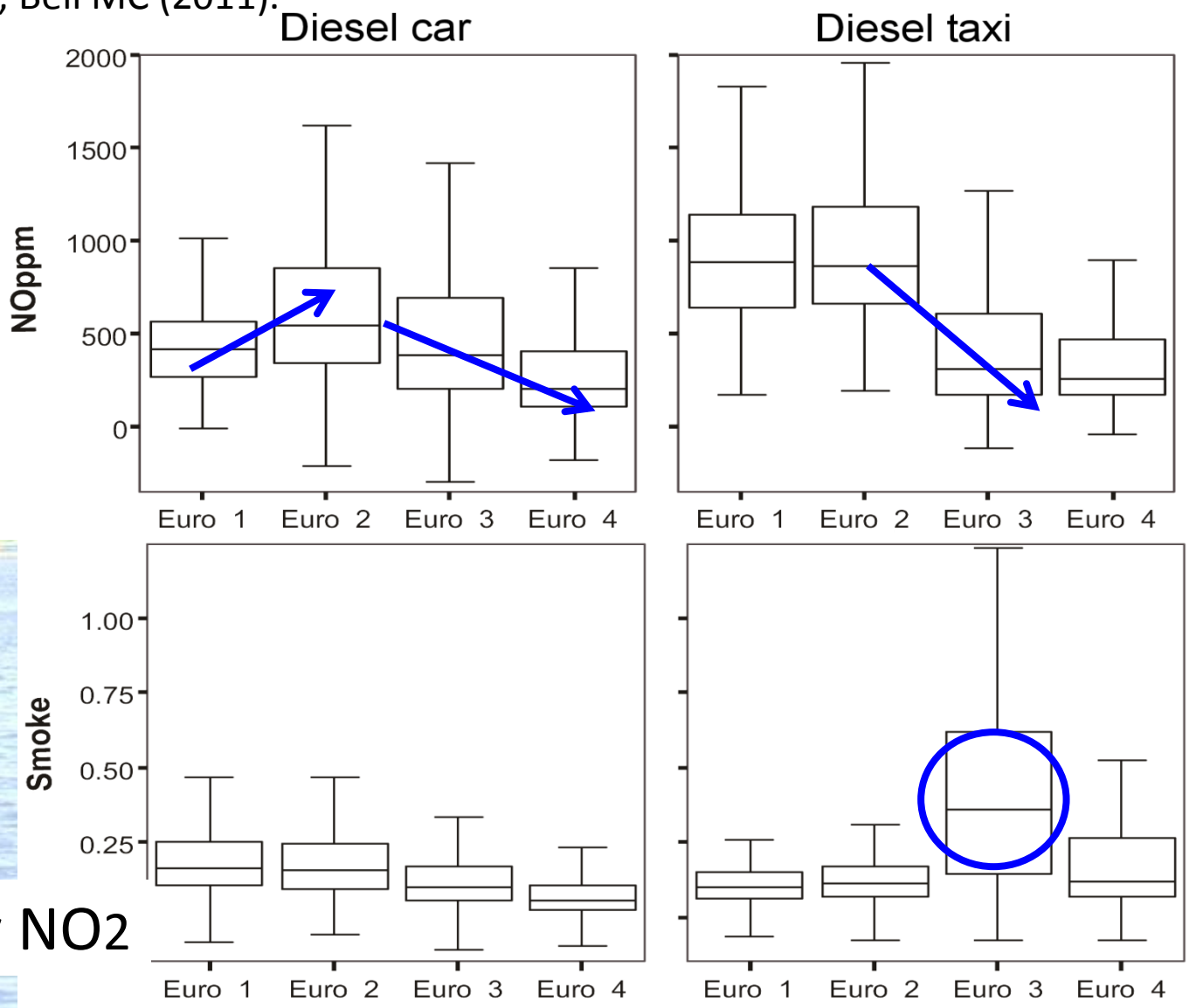
In reducing primary NO

Secondary NO_2 dropped

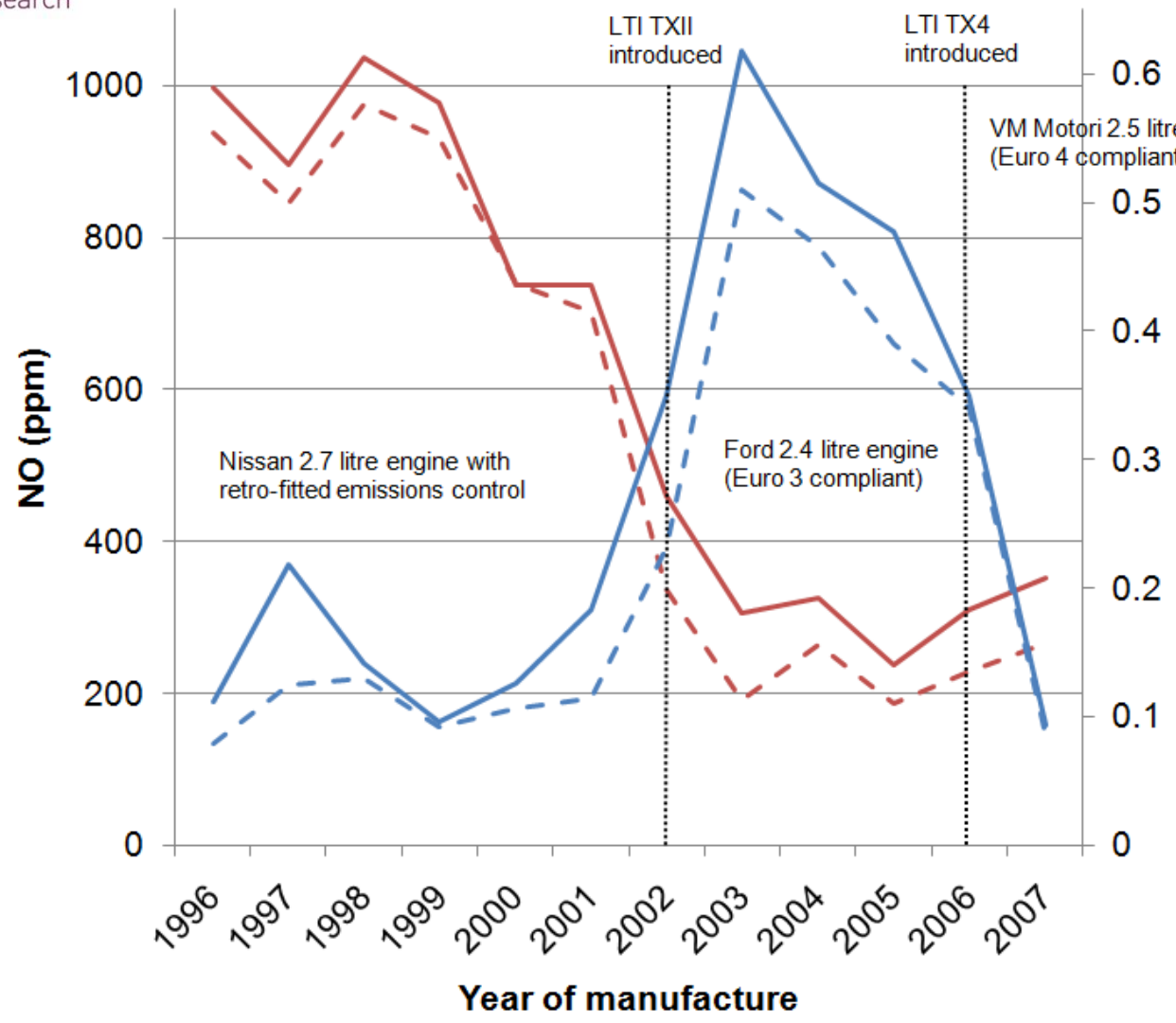
BUT Fine Particulates increased

Fitted TRAPS Regenerate particle filters

Increased primary NO_2



Futures Project - London (Black Cabs) – NO / Smoke



FUTURES project

55,000 tailpipe emissions

Particle Traps fitted - elevated emissions NO_2

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Air Quality: How are we doing?

Study of Marylebone site see Galatioto F., Bell M.C.,(2013) "Exploring the processes governing roadside pollutant concentrations in urban street canyon", Environmental Science and Pollution Research, http://dx.doi.org/10.1007/s11356-012-1428-5

Carslaw DC, Ropkins K, Bell MC. Change-point detection of gaseous and particulate traffic-related pollutants at a roadside location. *Environmental Science & Technology* 2006, **40**(22), 6912-6918.

Carslaw DC, Beevers SD, Bell MC. Risks of exceeding the hourly EU limit value for nitrogen dioxide resulting from increased road transport emissions of primary nitrogen dioxide. *Atmospheric Environment* 2007, **41**(10), 2073-2082.

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EPSRC
Pioneering research and skills

London - NO_2 µg/m³

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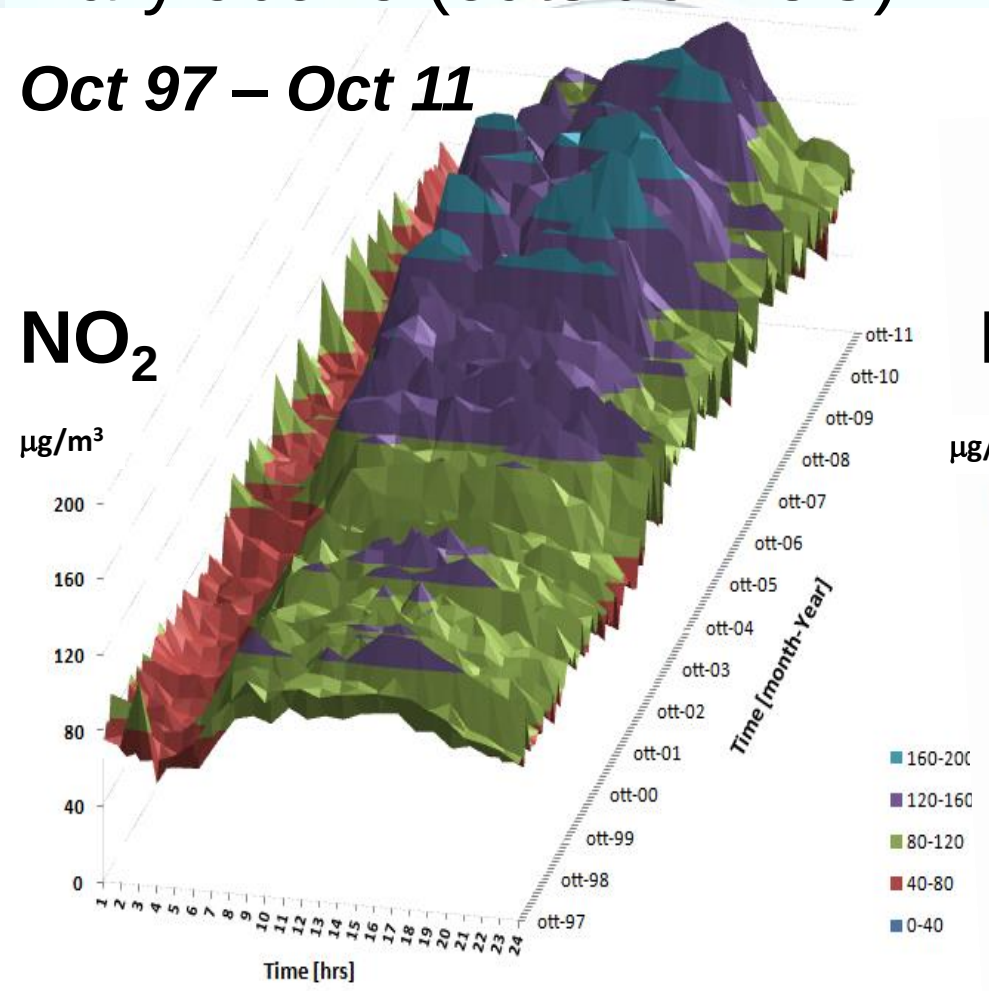
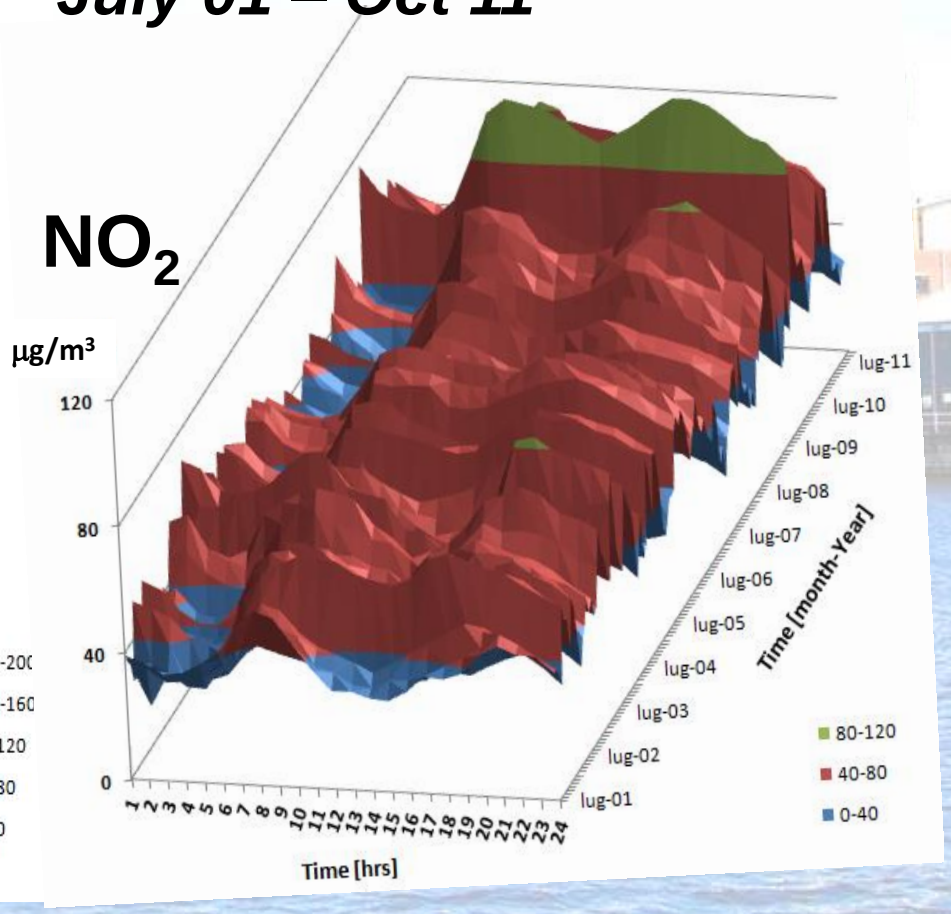
Marylebone (outside RUC)

Oct 97 – Oct 11



Westminister (inside RUC)

July 01 – Oct 11



Level and Duration increased since ~2005

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Comprehensive analysis of AURN demonstrating the increasing level and duration (persistence) of air pollution has been published in:

Bell, M.C., Galatioto F., Chakravartty, A., Namdeo, A.K., (2013)" A Novel Approach for investigating the trends in Nitrogen Dioxide levels in UK Cities", Environmental Pollution ENPO6969, 10.1016/j.envpol.2013.03.039
http://authors.elsevier.com/sd/article/S0269749113001723

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Air Quality: How are we Doing?

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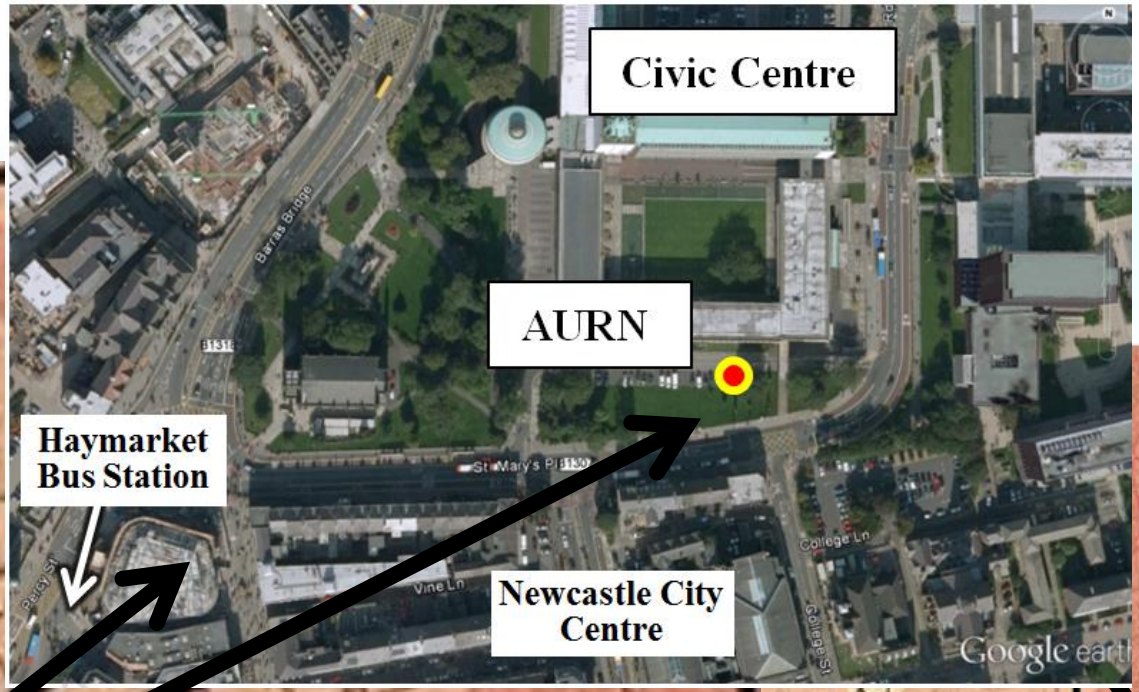

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Monitoring Air Quality

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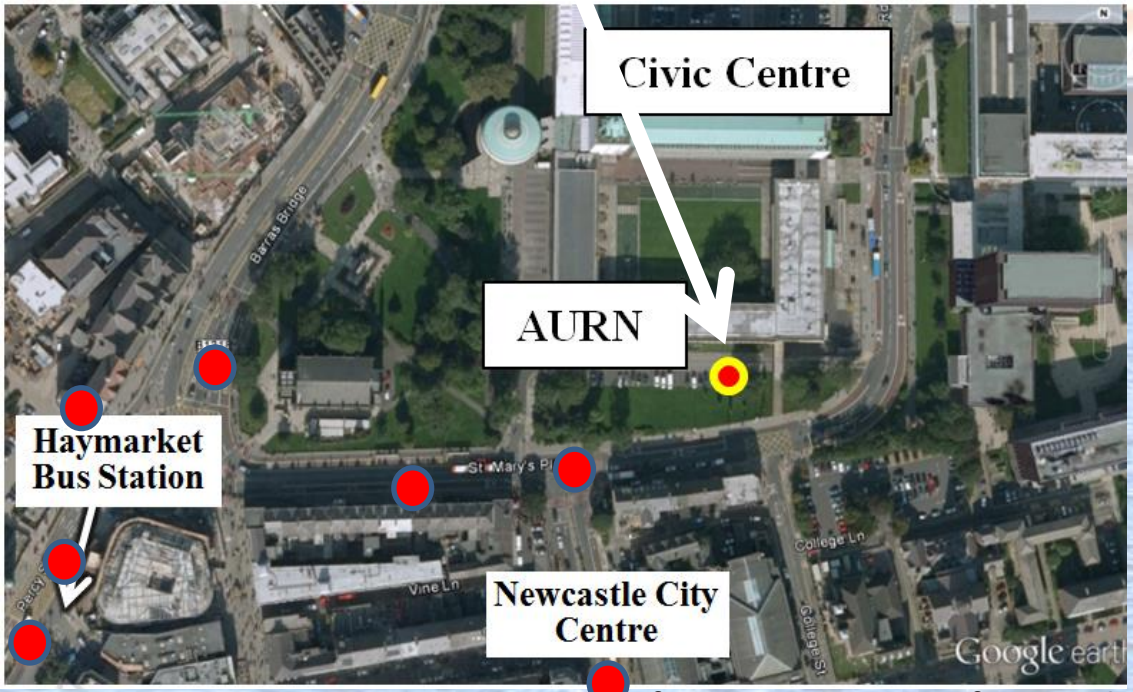
AURN Cabin



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Archive Data Analysis: AURN – Newcastle

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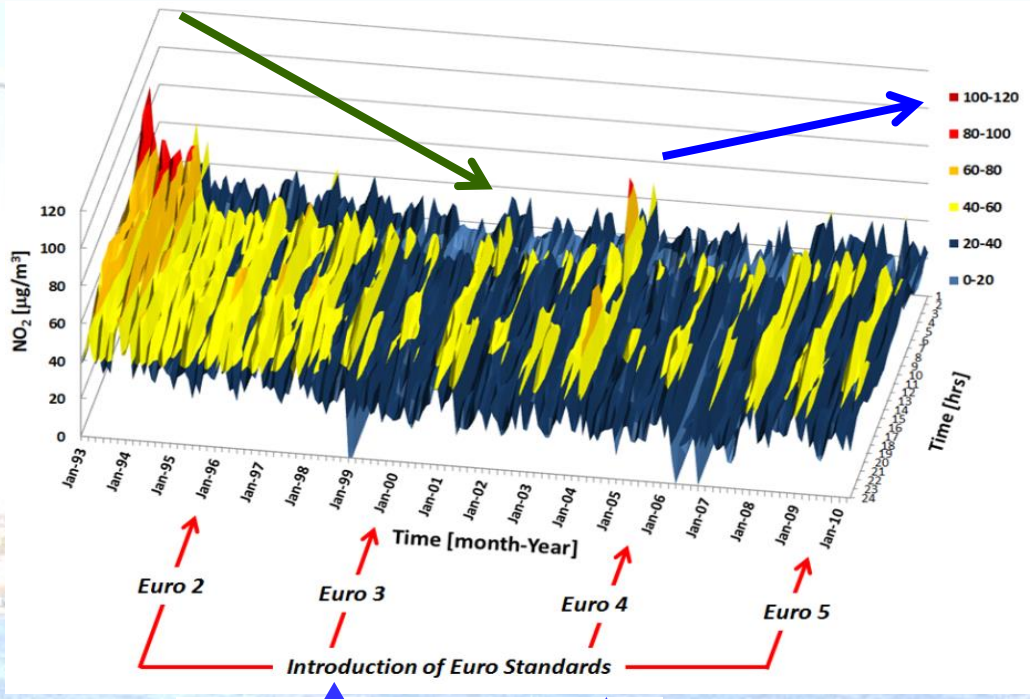

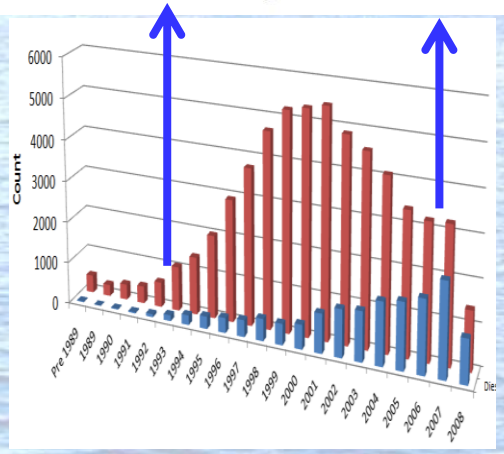

Regeneration Filters
Primary NO_2 increases

Euro 3 Diesels

Reduce VKT and promote public transport

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Air Pollution data analysis from the motes has been submitted for publication – currently confidential

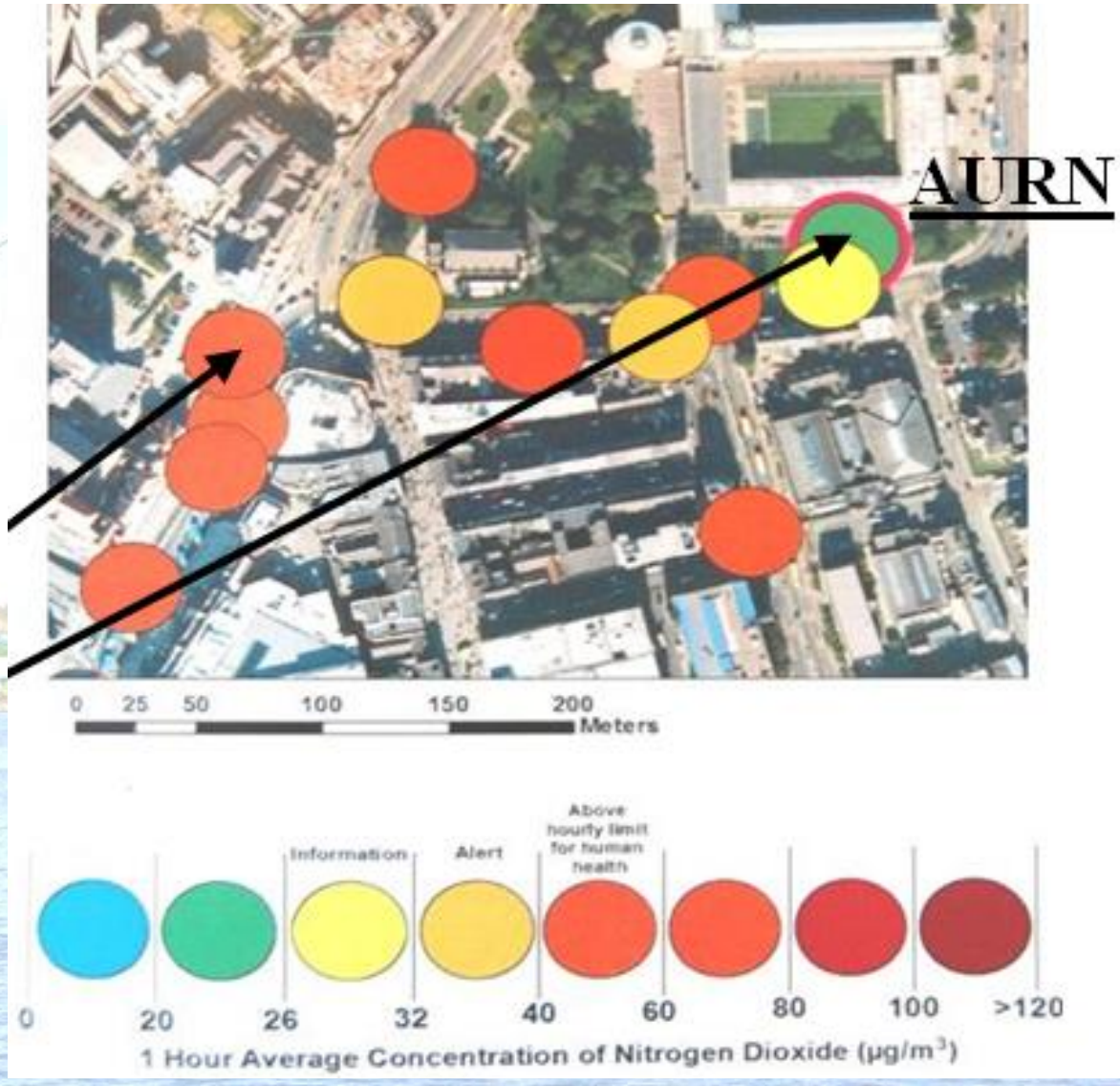
However, noise mote data analysis in Leicester see

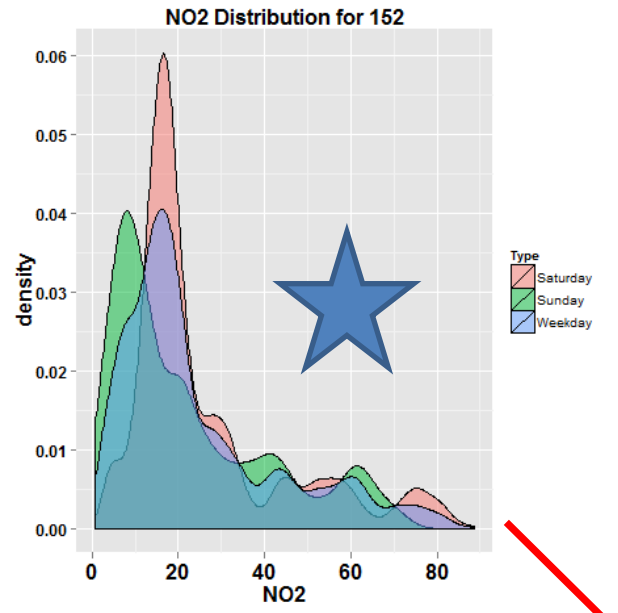
Bell M.C., Galatioto F., (2013) "Novel wireless pervasive sensor network to improve the understanding of noise in street canyons", Applied Acoustics 74, pp. 169-180, http://dx.doi.org/10.1016/j.apacoust.2012.07.007

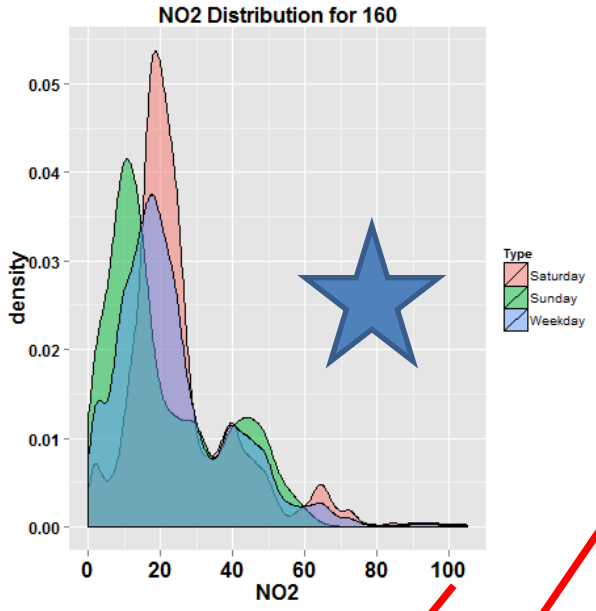
AURN versus Mote?

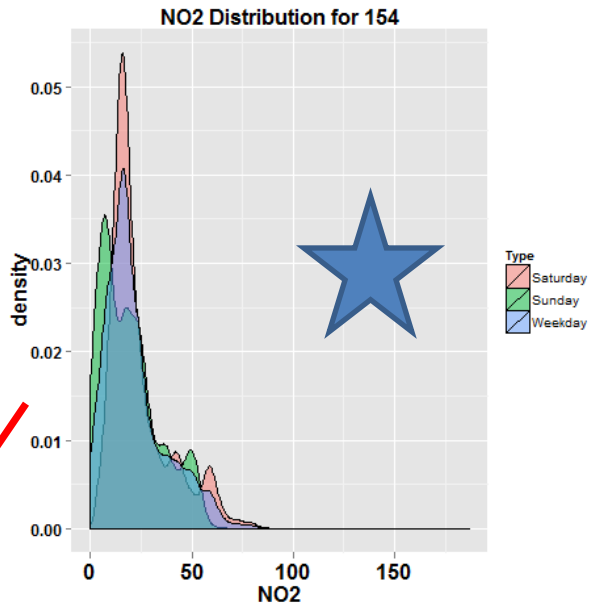
Roadside minute resolution

Background hourly

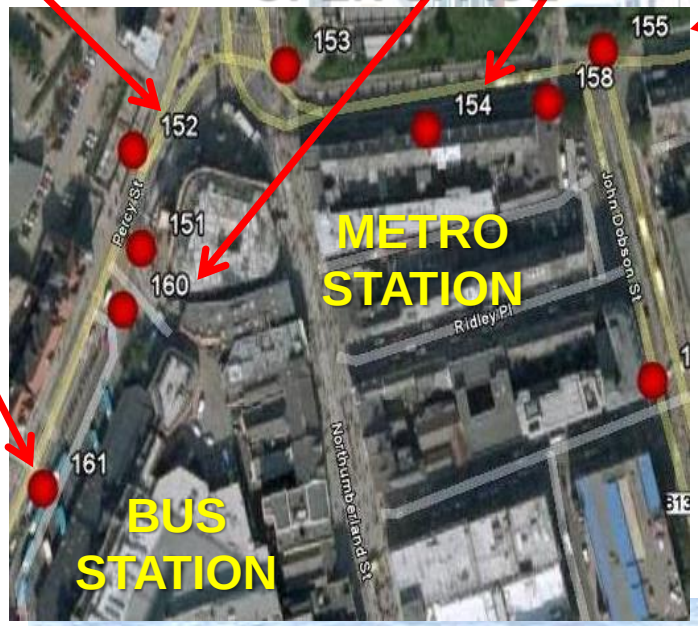


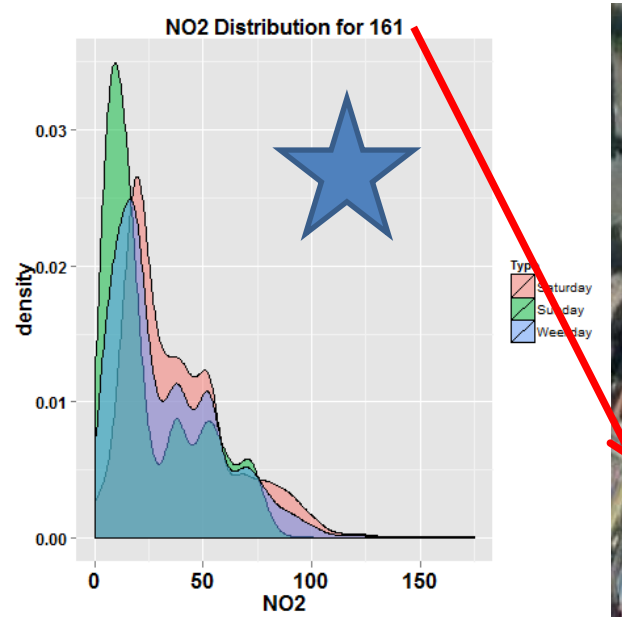


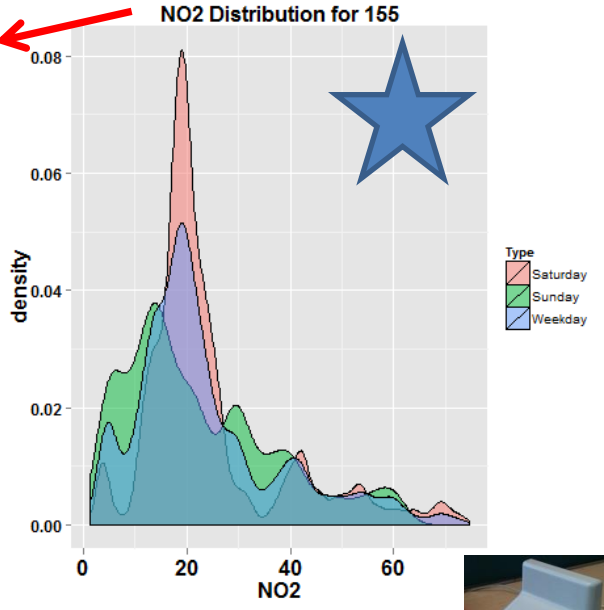




OPEN SPACE







Provides evidence of the causes of the pollution problems

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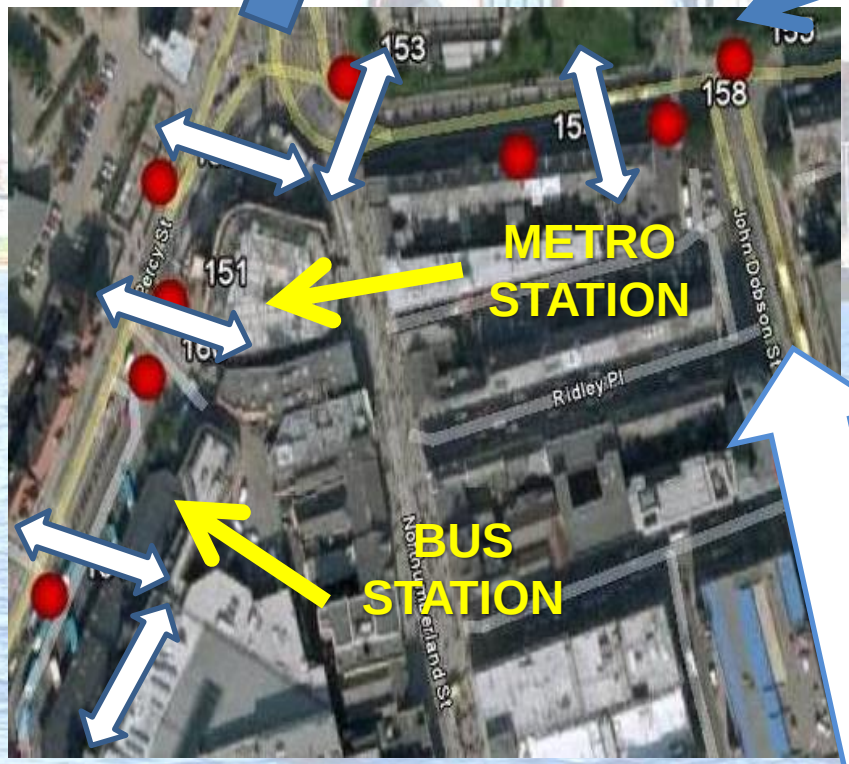
AQMA Newcastle Centre

High Bus flows into Haymarket Bus Station



Pedestrian Activity

High Bus flows and bus stops

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Potential Solution

- Avoid unnecessary pollution emissions during off peak flows when many buses with low passenger occupancy
- Manage pedestrian - bus interaction causing continuous stopping and starting of traffic and bus flows
- Promote bus-metro interchange
- Deliver bus-electric vehicle interchange at the edge of the city

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Can Public Transport Deliver win-win for carbon and air quality?

(This is confidential and not yet published)

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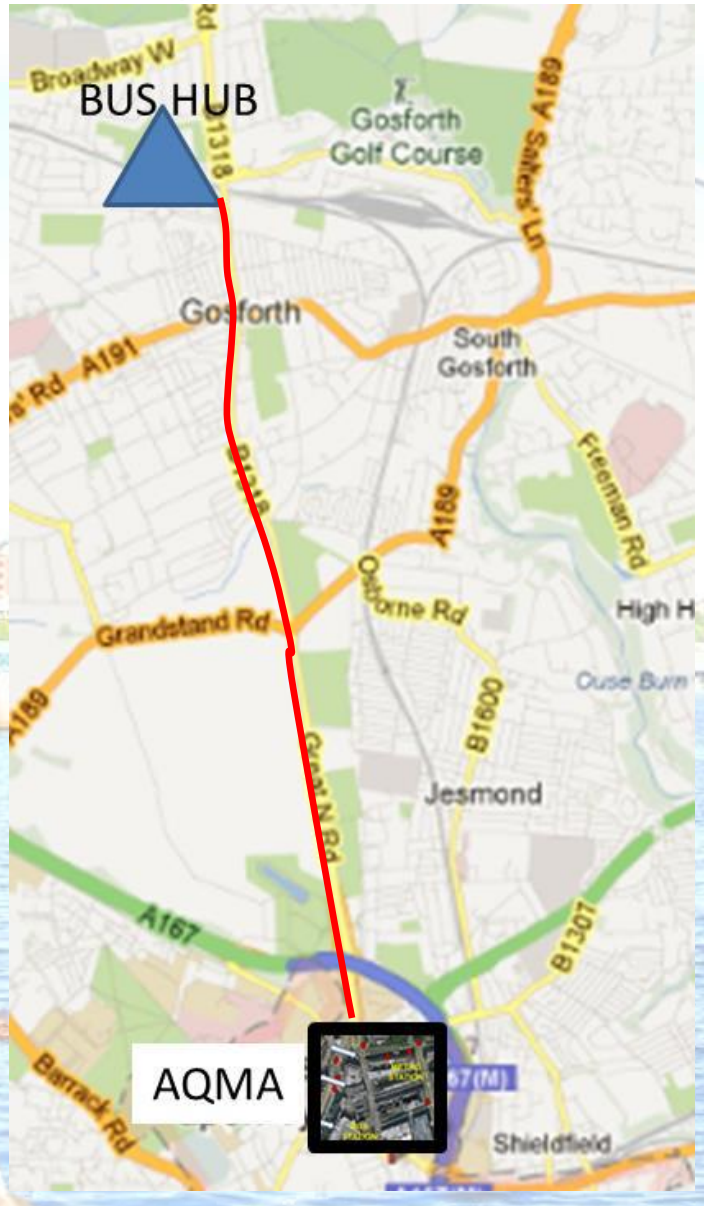
Bus-Bus Hub



- 0. Current Transport network for Gosforth
- 1. Bus hub - reduced number buses replaced with electric
- 2. Bus hub ditto with 10% modal shift 07:30- 08:45
- 3. Bus hub ditto with 20% modal shift 07:30 – 08:45
-

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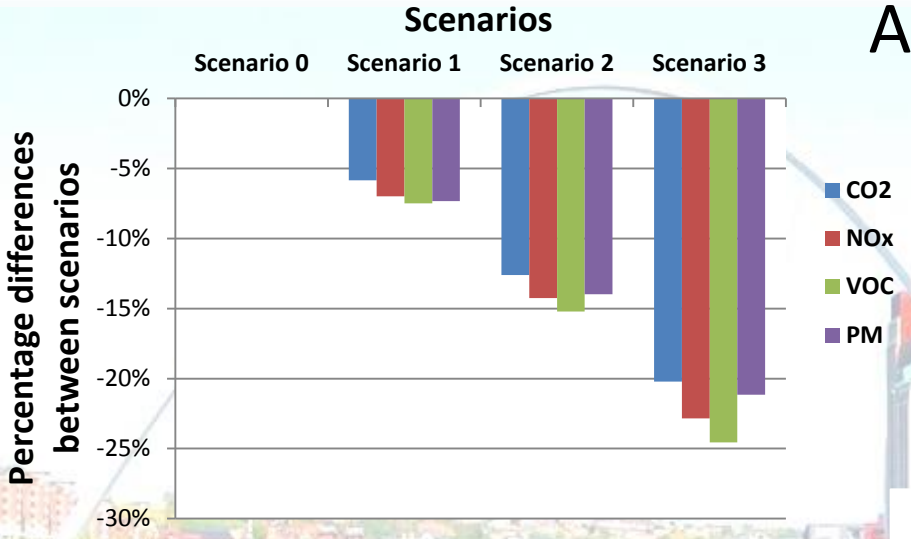
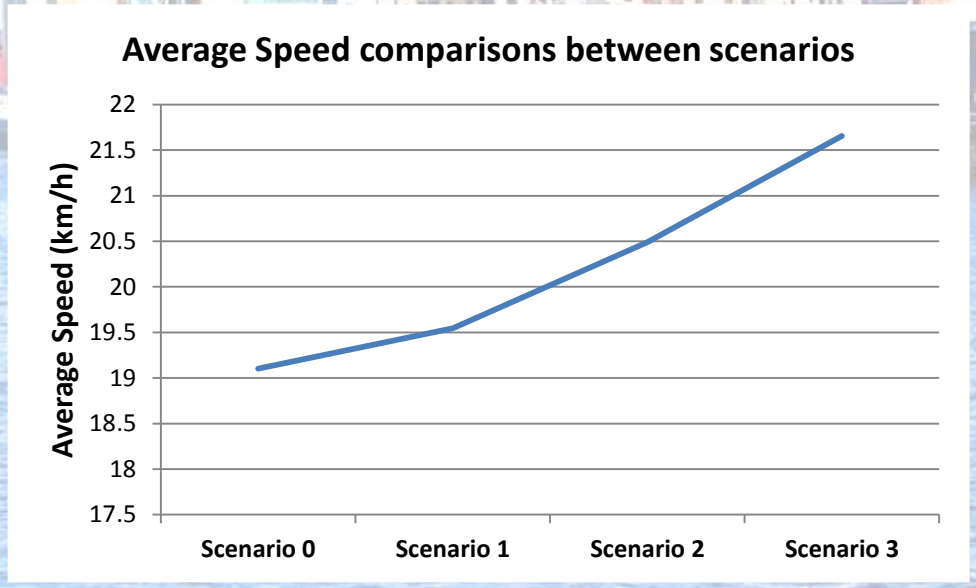
Carbon Savings



Air Quality problem addressed

Only 25% contribution against 67% reduction in level over 2010 needed by 2050



Over 4.2km saving of 1minute over a journey of 8.3minutes

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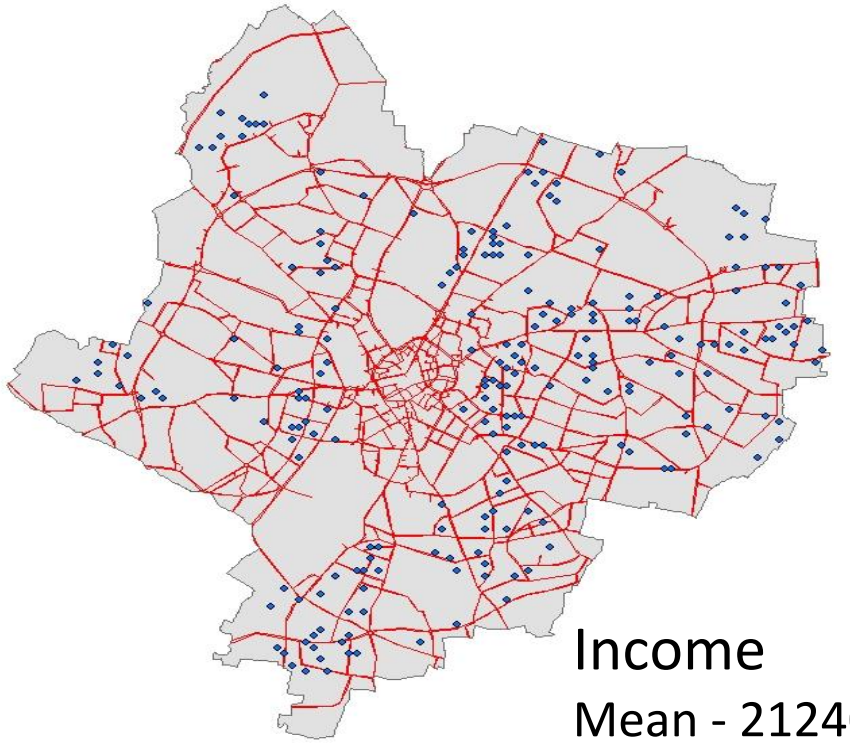
Magnitude of the Challenge

(This is confidential and not yet published)

EPSRC: SUE2 4M Project

Collaboration Newcastle with De Montfort, Sheffield Leeds and Loughborough Universities



Demographics Survey

- Respondents only
  - –Male - 288
  - –Female – 287
- Altogether across households
  - –Male - 763
  - –Female - 764

Income

Mean - 21240
Median - 18200
Lower Quartile - 7800
Upper Quartile - 29100

Employment status

Full Time 242
Part Time 68
Family/home 27
Retired 138
Unemployed 41
•Other 59

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Cross thematic Insights

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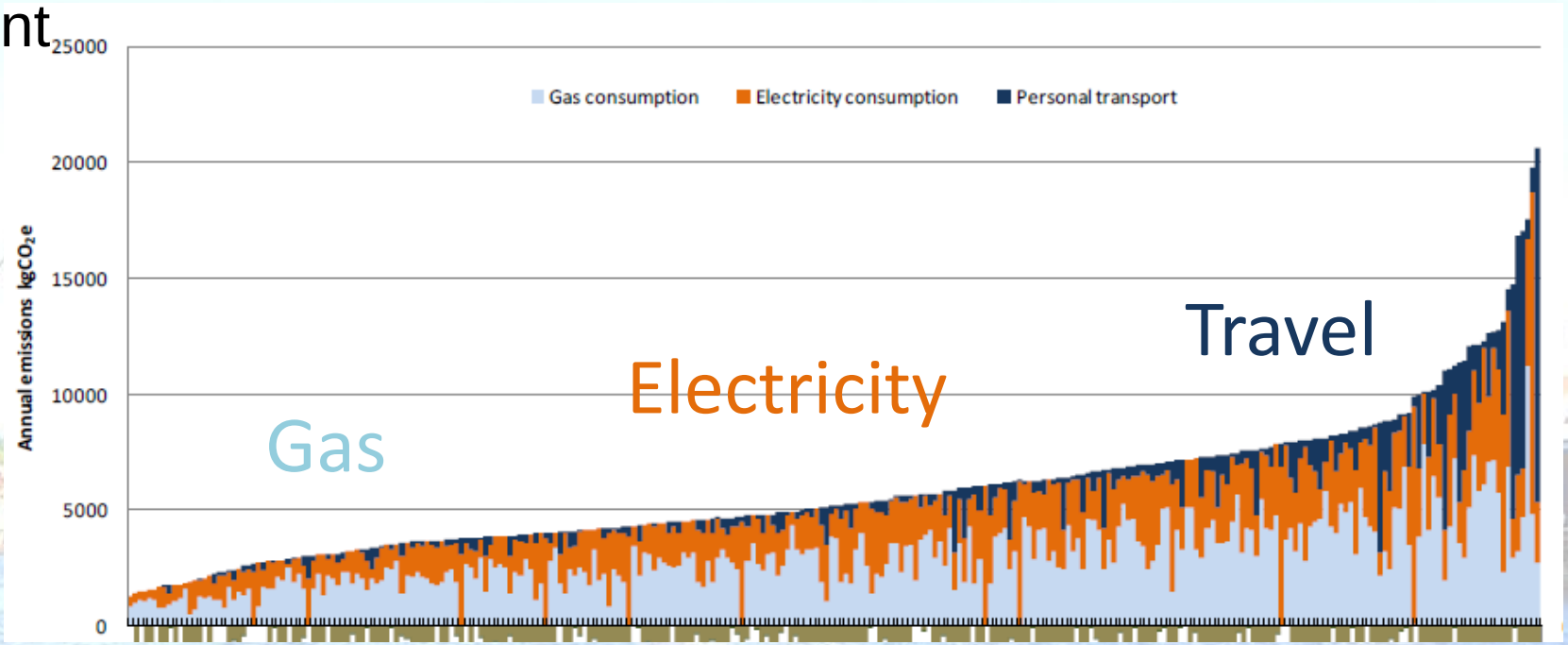
Annual emissions CO_2 equivalent



Cumulative stored CO_2

Medium and Long trips highest transport emissions

Energy used in home is ~1.75% that saved by not going into work

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Enormity of the problem of reaching carbon targets

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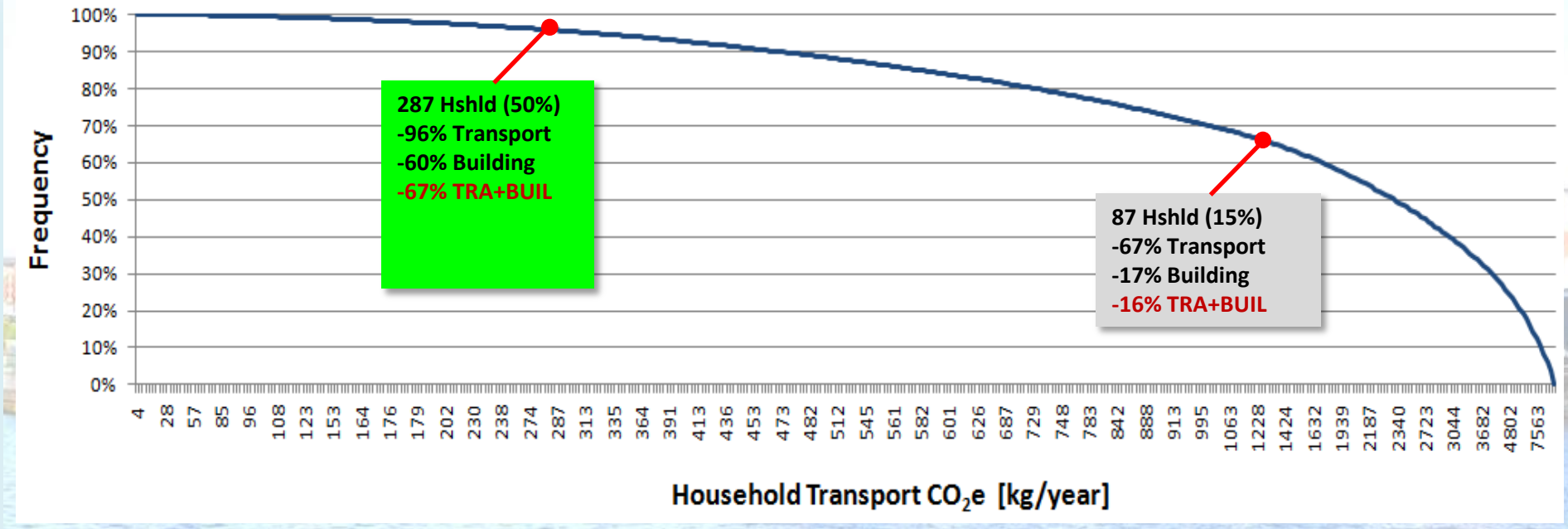
How do we reach our carbon targets of 67% reduction over 2010 levels by 2050?



The 50% of our highest emitters cannot travel (96%) and not use energy in the household (60%) to meet targets

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NUIDAP – Role in environment management

This work is not yet published but implemented in Medway. There are several Conference papers demonstrating the application and can be implemented by AMEY. Please consult website.

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Legacy System Data

Data available as a by- product of AQ monitoring & Traffic control & management

AURN | SCOOT | ANPR | MET | ..... | LEGACY

- Other data sources include
  - MIDAS – motorways
  - Road Conditions
  - Bus tracking
  - Car park information systems
  - Remote counts composition
  - etc

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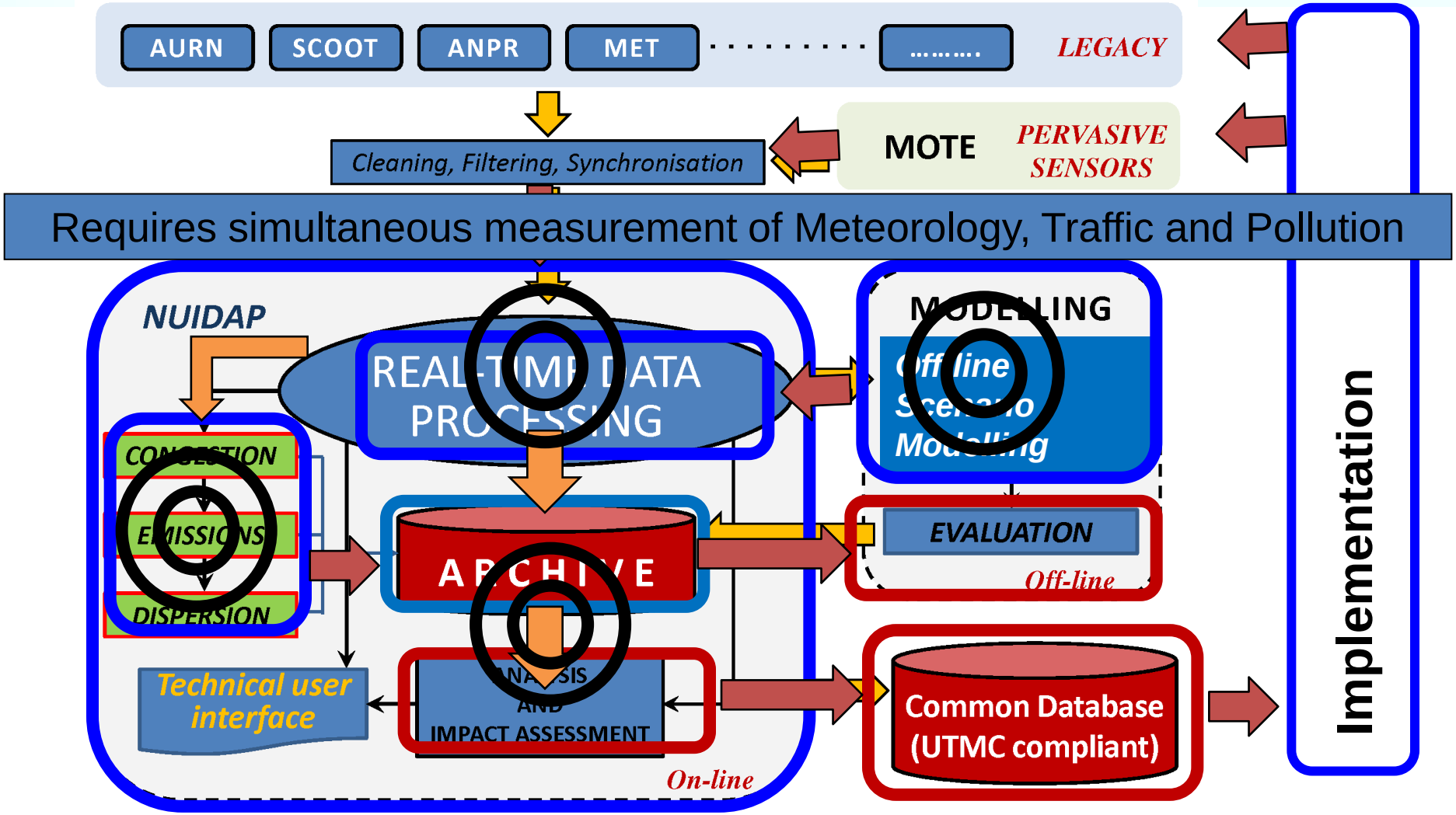
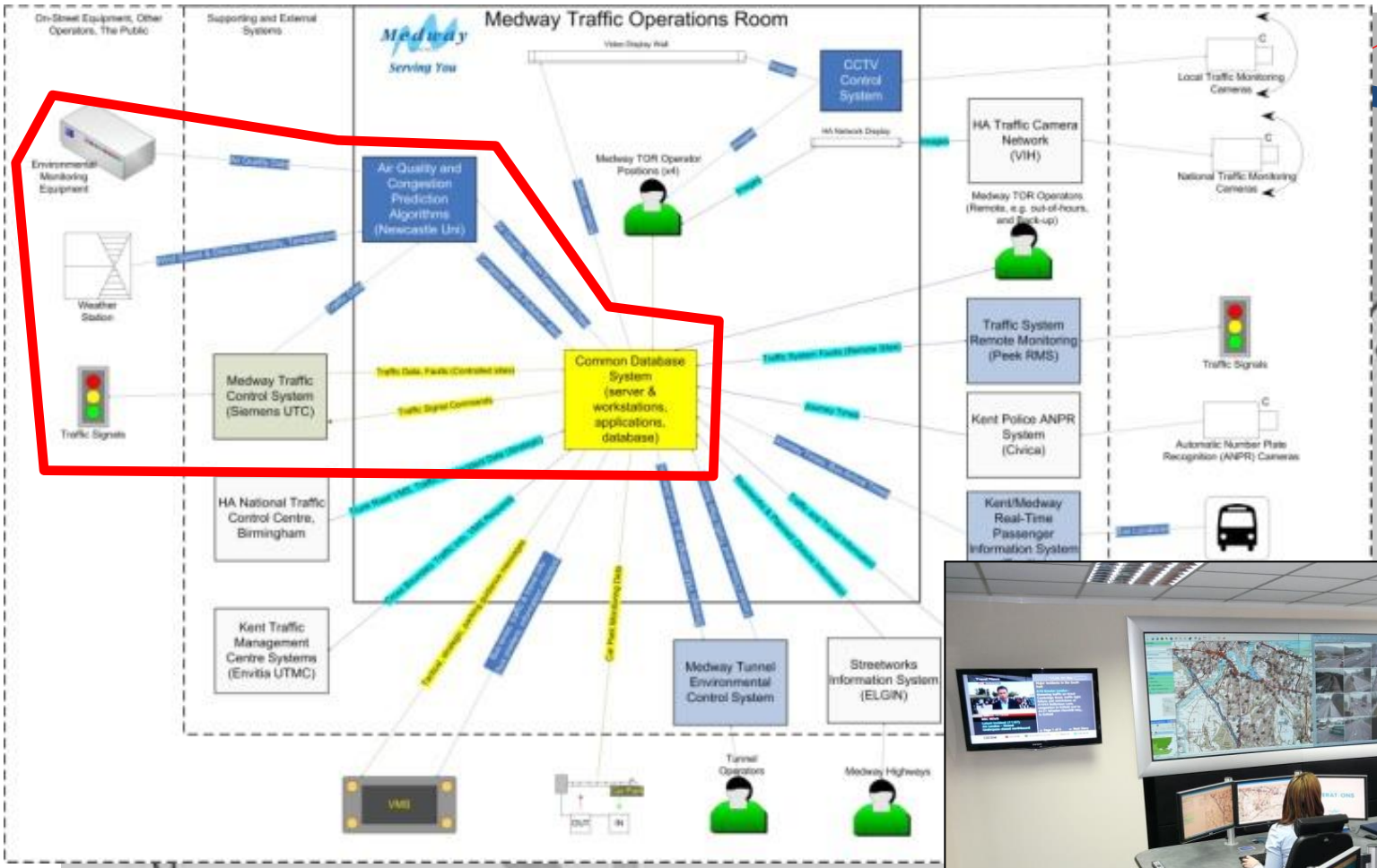
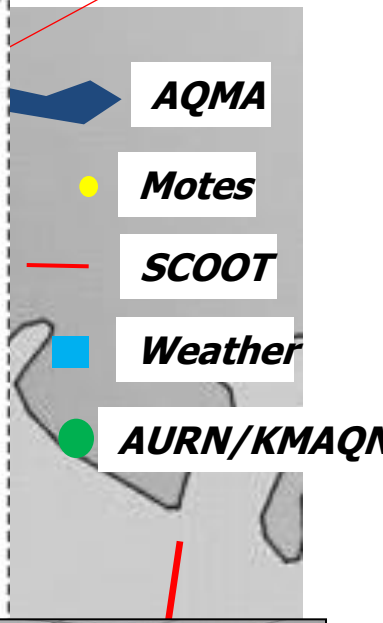
NUIDAP

Newcastle University Integrated Database & Assessment Platform



Air Quality Management and UTMC Medway – A Summary





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Summary

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- Over decade 1998-2007 all benefits new technologies eroded - increase 3% in eCO_2
- Over almost two decades 1992-2010 Government policies and new technologies have exacerbated air quality NO_2 air quality events prevailing for longer
- Congestion & high volumes of buses largely empty during day contribute unnecessarily to AQMA
- Public Transport Interchange reduce Carbon Emissions typically of the order of 10% unless there is also a mode shift from private vehicles into buses
- 20% mode shift typically 20%-24% CO2/VOC/ PM10/ NOx emissions reduction
- Green Travel Plans do not stack-up if heating (cooling) are used at home

➢ The 50% of our highest emitters cannot travel (96%) and not use energy in the household (60%) to meet targets

➢ Even with INTEGRATED APPROACH a HUGE shortfall meeting target of 67% over 2010 by 2050

➢ Need to make substantial in-roads in significantly conducting DAY to DAY activity WITHOUT MOTORISED transport

➢ Implications for traffic signal control and Management

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Some Actions

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Manage Networks mindful of tailpipe emissions

- Locate queues in ventilated areas of the urban environment
- Smooth flows, avoid stopping vehicles uphill
- Avoid acceleration, deceleration events > conflicts between pedestrians, cycles, vehicles
- Reduce volumes to reduce congestion > shorter cycle times
- Promote public transport > people movements
- Flexible development of networks and infrastructure to accommodate higher levels of non motorised travel walking, cycling
- etc

Final Comment

- Scientific Evidence AFFIRMS way western world lives is UNSUSTAINABLE and FUNDAMENTAL changes are needed
- Non motorised travel options have to become the NORM
- Essential STEP-CHANGE needed will take decades
- QUALITY of LIFE does not have to be COMPROMISED
  - Environmentally sustainable travel
  - Healthier
  - Pleasanter places to live

Require a VISION – long term goals

Path to Follow

SHORT TERM goals to deliver incrementally

INNOVATION driven by Public transport and managing conflicts and reducing pedestrian and cycle delays

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Acknowledgement

- EPSRC and DfT for funding of the research discussed
- Colleagues and Students at the Transport Operations Research Group, Newcastle University for commitment and dedication to good quality research.
- Tyne and Wear, Stagecoach for support in kind to providing data and supporting bus surveys etc.

Please take opportunities to reference the research presented. Consult the Reference list on the Personal webpage at the University www.newcastle.ac.uk

or Contact Margaret Bell directly.

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Thank You for Listening
Any Questions?

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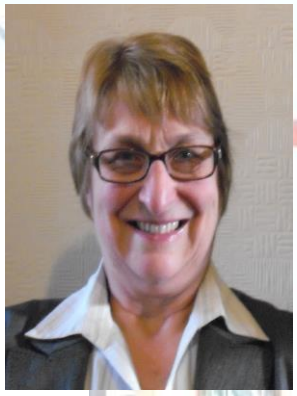
Prof Margaret Bell CBE

Science City Professor in Transport and Environment, margaret.bell@ncl.ac.uk



Professor Bell was honoured as CBE, Commander of the British Empire for her services to Sustainable Transport in 2006 and is the Chair of the ITS(UK) Smart Environment Interest Group which was launched at 13th ITS World Congress in London in 2001

Professor Bell's has almost forty years of research experience which embraces monitoring, modelling and management of traffic, emissions, air quality, noise and exposure; evaluation of health and carbon emissions impacts.

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