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

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This presentation

• 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
Policy

**BINDING TARGETS**: Reduce CO₂ 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
Carbon Emissions: How are we doing?

This research is currently being prepared for publication therefore confidential.
Carbon Emissions
How are we doing?

1990 → 2013 → 2050

- 1990: Question mark
- 2005: 80% of 1990
- 2010: 67% of 1990
- 2050: 67% of 1990

Leicester SCOOT database

1987 → 1998 → 2011 → 20... → 2050

- 1987: 2 Regions
- 1998: ~600 links
- 2011: ~900 links
- 2050: ....

Model change in UK Fleet emissions over time
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.
Tailpipe Emissions data analysis has been published in:


To view the full paper see [http://pubs.acs.org/articlesonrequest/AOR-Dwwp8izvGJF8vx9TY7y5](http://pubs.acs.org/articlesonrequest/AOR-Dwwp8izvGJF8vx9TY7y5) (registration required).
Fuels and Engine Technologies

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 CO₂

Car manufacturer’s continued efforts making engines more efficient to reduce CO₂ and NO
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

- Particle Traps fitted - elevated emissions NO₂
- FUTURES project
- 55,000 tailpipe emissions

Graph showing NO and Smoke Number emissions from 1996 to 2007, with key milestones:
- 1997: LTI TX11 introduced
- 2002: LTI TX4 introduced
- 2004: Ford 2.4 litre engine (Euro 3 compliant)
- 2006: VM Motori 2.5 litre engine (Euro 4 compliant)

- Nissan 2.7 litre engine with retro-fitted emissions control
- Smoke ppm mean vs Smoke ppm median
- NO ppm mean vs NO ppm median
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.
London - NO$_2$ μg/m$^3$

Marylebone (outside RUC)

Oct 97 – Oct 11

Westminster (inside RUC)

July 01 – Oct 11

Level and Duration increased since ~2005
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
Air Quality: How are we Doing?
Monitoring Air Quality

AURN Cabin

Civic Centre

Haymarket Bus Station

Newcastle City Centre

JCT Conference, University of Warwick

19th - 20th September 2013.
Archive Data Analysis: AURN – Newcastle

Regeneration Filters
Primary NO2 increases

Euro 3 Diesels

Reduce VKT and promote public transport
Air Pollution data analysis from the motes has been submitted for publication – currently confidential.

However, noise mote data analysis in Leicester see

AURN versus Mote?

Roadside
minute
resolution
Background
hourly

19th - 20th September 2013.

JCT Conference, University of Warwick
Provides evidence of the causes of the pollution problems

19th - 20th September 2013.
AQMA Newcastle Centre

High Bus flows into Haymarket Bus Station

Pedestrian Activity

High Bus flows and bus stops
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
Can Public Transport Deliver win-win for carbon and air quality?

(This is confidential and not yet published)
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
Carbon Savings

Air Quality problem addressed
Only 25% contribution against 67% reduction in level over 2010 needed by 2050

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

(This is confidential and not yet published)
Demographics Survey

• Respondents only
  – Male - 288
  – Female - 287

• Altogether across households
  – Male - 763
  – Female - 764

Employment status

- Full Time 242
- Part Time 68
- Family/home 27
- Retired 138
- Unemployed 41
- Other 59
Cumulative stored CO₂

Medium and Long trips highest transport emissions

Energy used in home is ~1.75% that saved by not going into work
Enormity of the problem of reaching carbon targets

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.
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.
Legacy System Data

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

- AURN
- SCOOT
- ANPR
- MET

Other data sources include
- MIDAS – motorways
- Road Conditions
- Bus tracking
- Car park information systems
- Remote counts composition
- etc
NUIDAP
Newcastle University Integrated Database & Assessment Platform

Requires simultaneous measurement of Meteorology, Traffic and Pollution

Implementation
Air Quality Management and UTMC
Medway – A Summary

- Introduction
  - Medway UTMC & AQM

- Motes
- SCOOT
- Weather
- AQMA
- AURN/KMAQN
Summary

- Over decade 1998-2007 all benefits new technologies eroded - increase 3% in eCO₂
- Over almost two decades 1992-2010 Government policies and new technologies have exacerbated air quality NO₂ 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
Some Actions

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

19th -20th September 2013.
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- 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](http://www.newcastle.ac.uk) or Contact Margaret Bell directly.
Thank You for Listening
Any Questions?
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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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