Department for Transport

Ealing
www.ealing.gov.uk

Active management of urban road network air quality 'hot spots'

Exhaust emissions from queuing road vehicles at traffic signals

DfT Local Transport Air Quality Challenge Innovation Grant 2015

CIEH London Region Pollution Study Group - May 4th 2016

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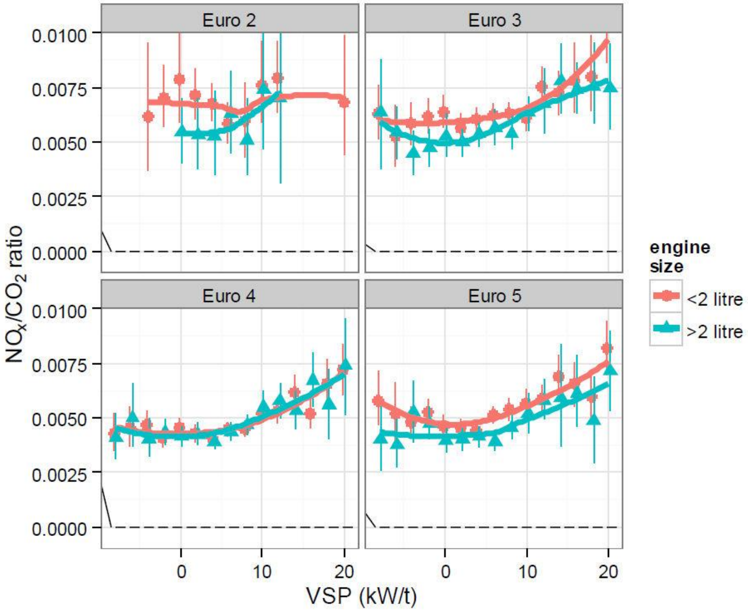
Background (1)

Defra funded roadside remote sensing surveys of vehicle exhaust emissions implemented in Ealing and City of London in 2012;

Notable as the first UK 'fleet wide' speciated measurement of NO_2 and NO explicitly;

Measured molar ratios of pollutants to CO_2 (NO/CO_2, NO_2/CO_2, CO/CO_2 etc);

Provided a very useful dataset on the relationships between pollutants and vehicle technology, Euro class, fuel type, and vehicle dynamics.



Background (2)

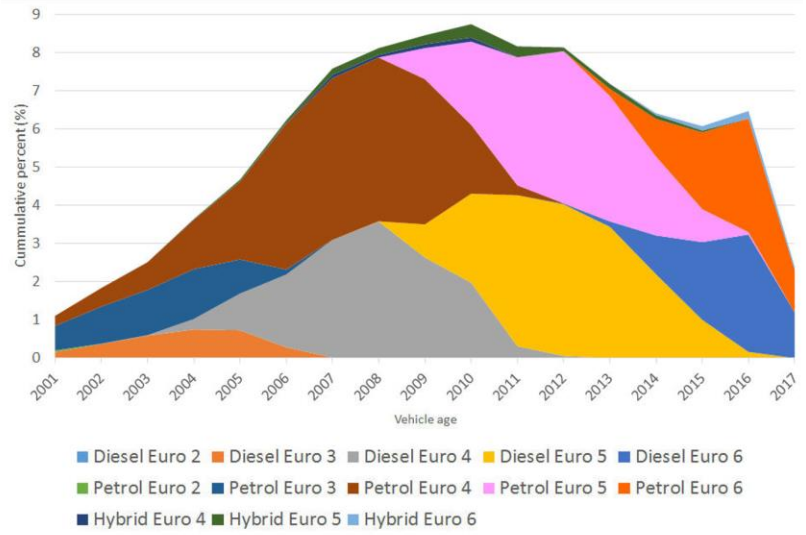
Defra funded project in 2013/14: "*Scenario development to inform air quality action planning in Ealing*";

Utilised the 2012 remote sensing dataset as a foundation, investigating a number of case study locations in Ealing;

One of the observations within the project was how much journey time was spent stationary (8% to 40%, depending on location);

6% to 33% of journey time within case study locations was observed to be spent stationary for periods of 10 seconds or more. ***Potential opportunity…???***

Passenger car fleet mix at 2017



Emissions 'hot spot' due to queuing

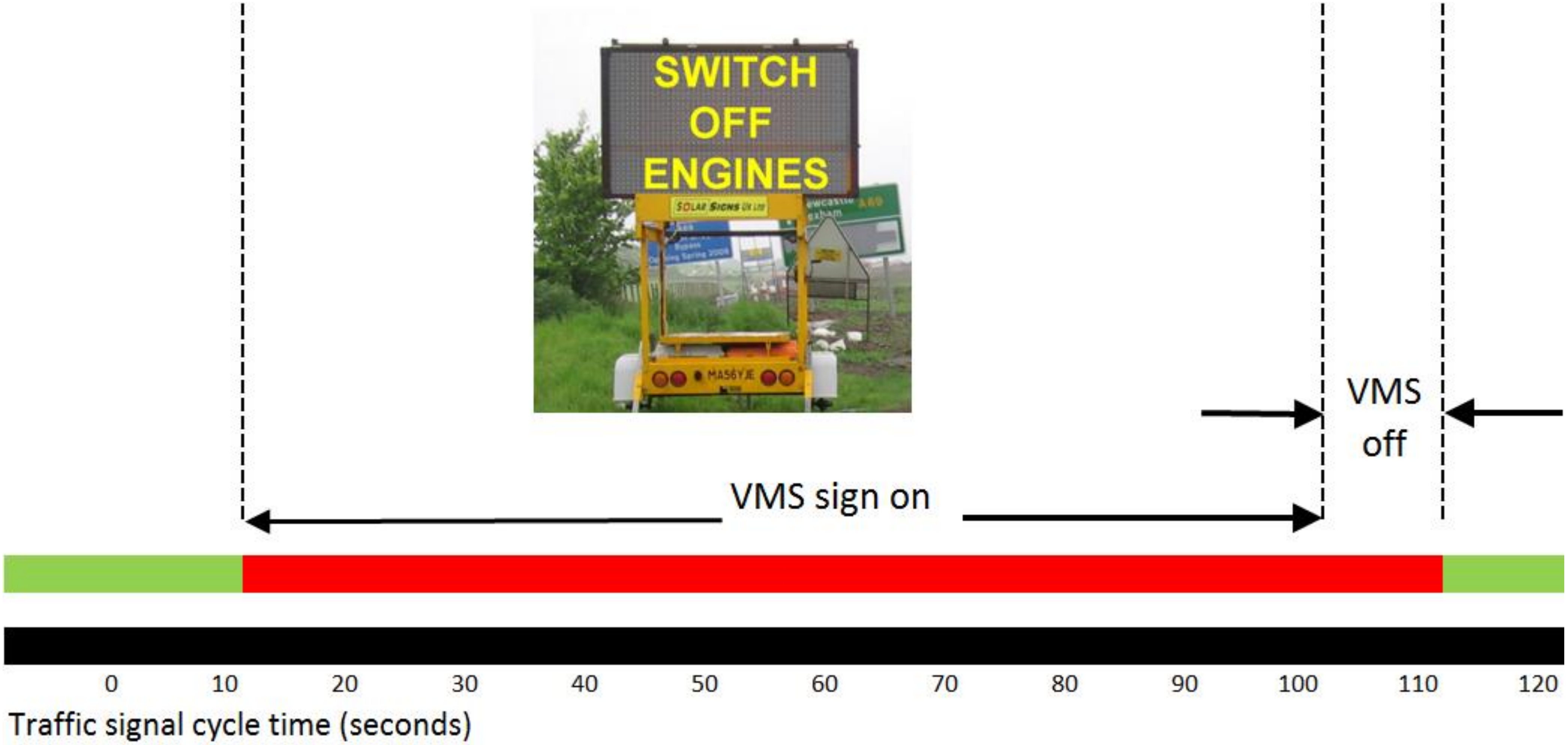
Basic concept

Given the amount of time spent stationary, it is hypothesised that if all (*or a significant proportion of*) vehicle engines are consistently switched off during these stationary periods, there could be a significant reduction in emissions at these ‘hot spots’;

Problem: The driver does not know how long a stop will be. Does not have adequate information to make a decision (switch off or idle?). Need to provide the driver with real time information on the likely length of delays;

Challenges: Vehicle technology, urban traffic control infrastructure, and driver behaviour.

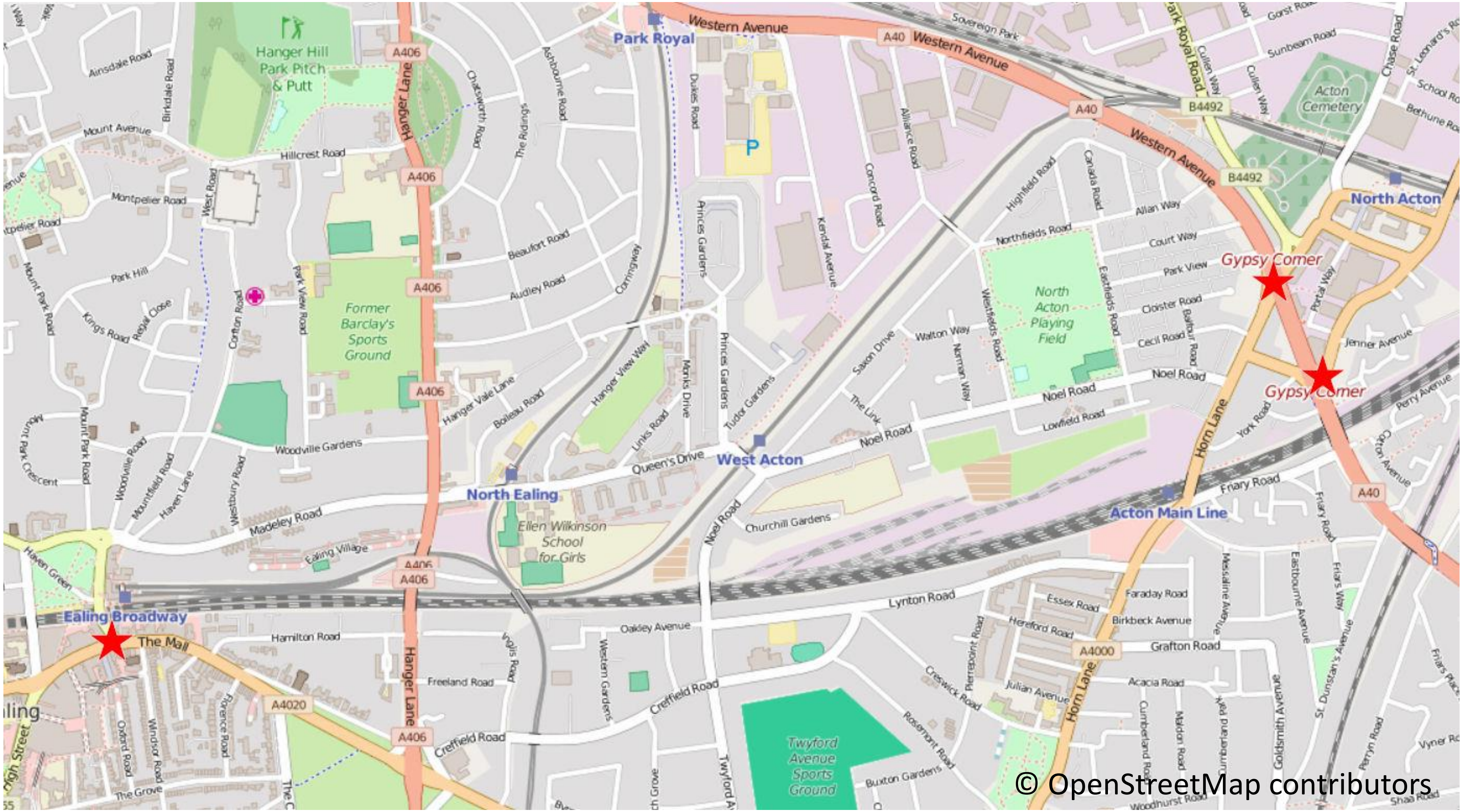
Basic concept



Method

- Short feasibility study (December 2015 to March 2016);
- Case study location selection within Ealing;
- Consultations with TfL, LB of Ealing, and VMS supplier;
- Site visits and additional data collection;
- Refinement of vehicle emissions (and fuel consumption) assumptions;
- Postal survey of light vehicle manufacturers.

Case study locations in Ealing



Horn Lane northbound approach to A40

Wales Farm Road southbound approach to A40

Ealing Broadway southbound approach to Uxbridge Road

Consultations (1)

TfL traffic engineering:
Practical challenge – SCOOT adaptive traffic control at all the case study locations. The system does not know when the traffic lights will change from ‘red’ to ‘red/amber’ until 1 – 4 seconds before it happens.

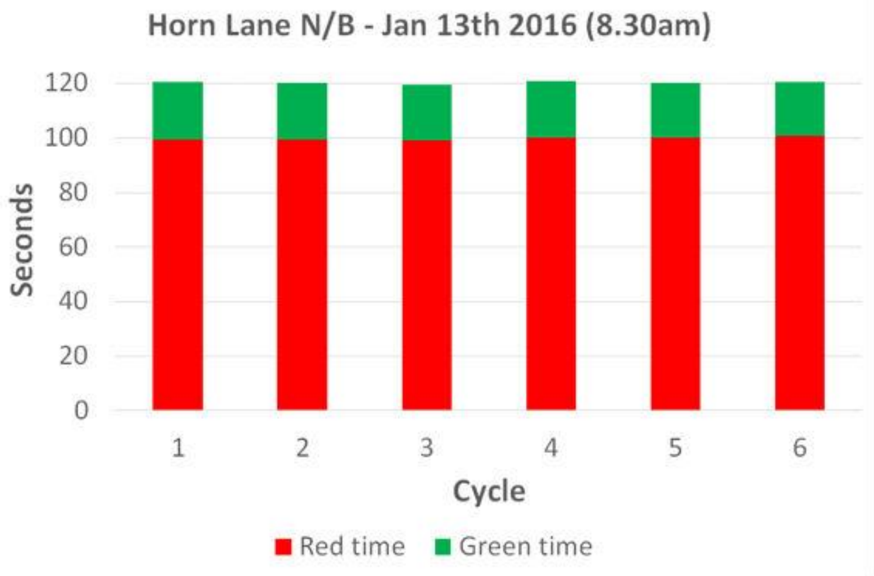
TfL research:
Useful lessons gained from the TfL ‘No idling’ campaign in 2012.
More than just a campaign is required; drivers need specific instructions / information.
A barrier to no-idling is unpredictable wait times; mechanisms to help drivers to predict wait times could help to overcome this (e.g. systems at traffic lights to show green-red change times)

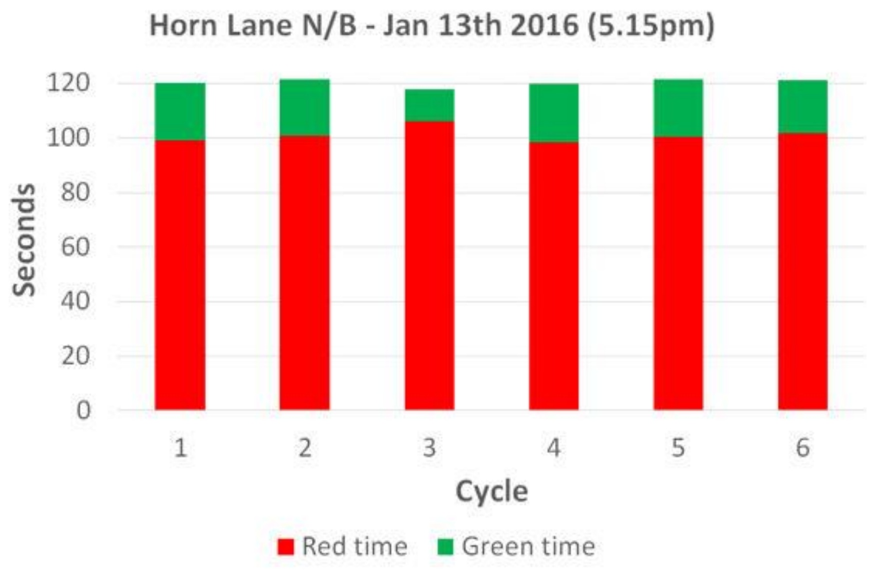
Consultations (2)

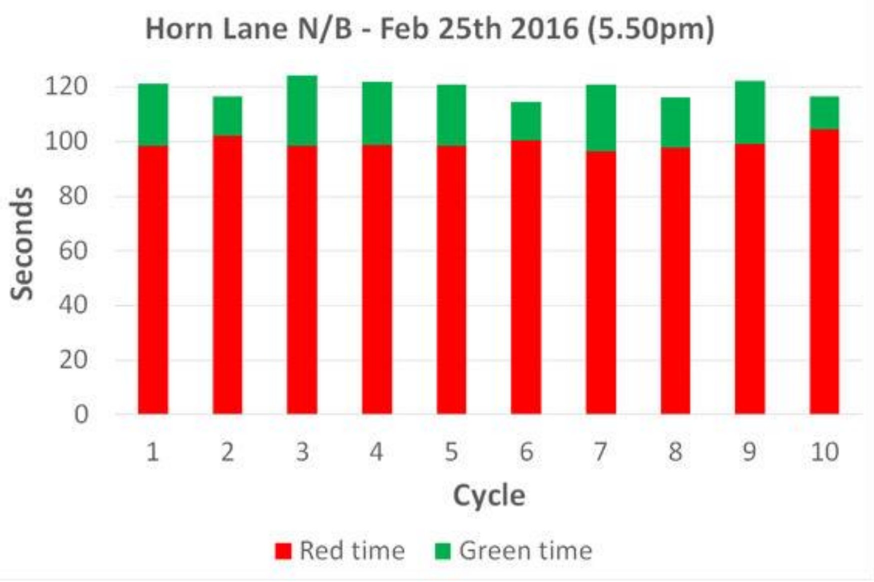
London Borough of Ealing:
VMS signs can tend to lose their impact over a period of time.
Implement in conjunction with a wider behaviour change programme.
Utilisation of multiple media channels.
Need to quantify costs and benefits, and ongoing maintenance costs.

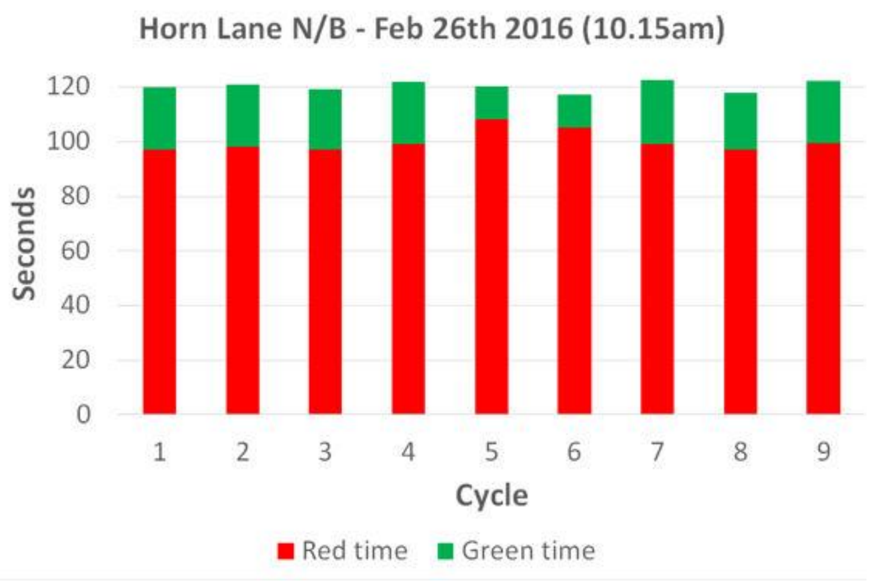
Industry VMS supplier:
Systems already exist to integrate variable message signing with urban traffic control systems.
Wireless communications.
Additional development of system logic would be required.

Horn Lane northbound sample signal timings

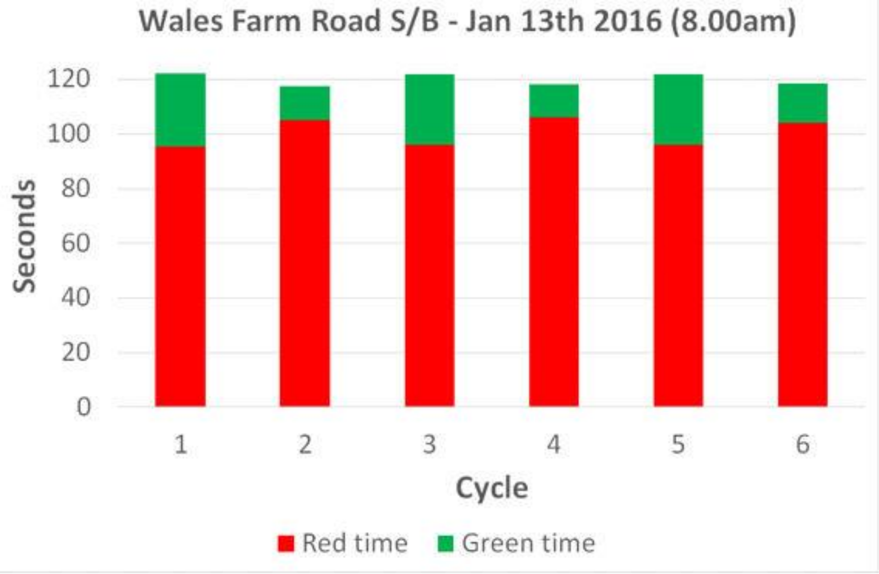


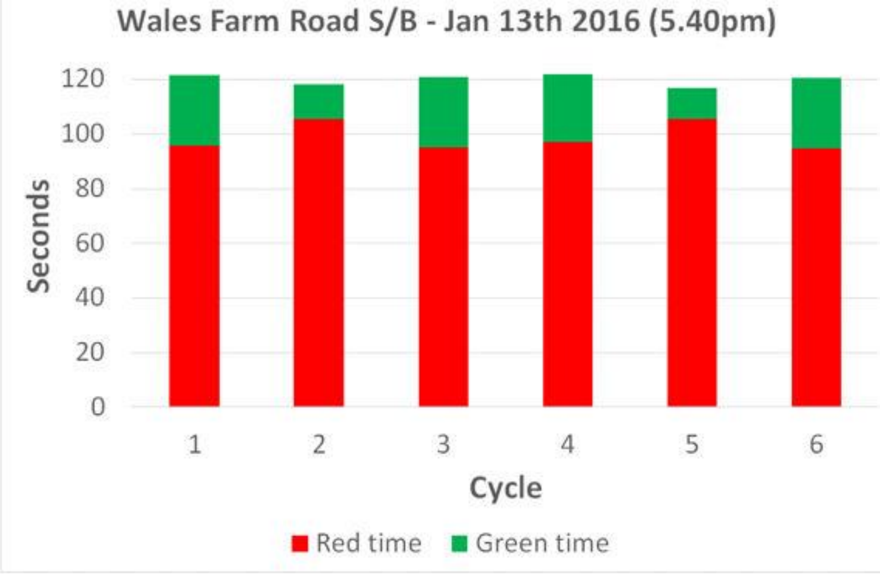


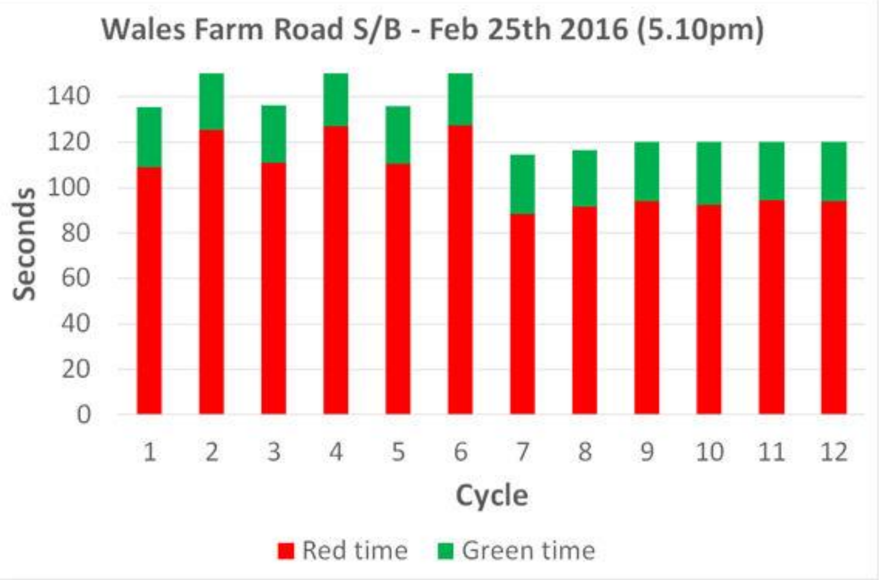


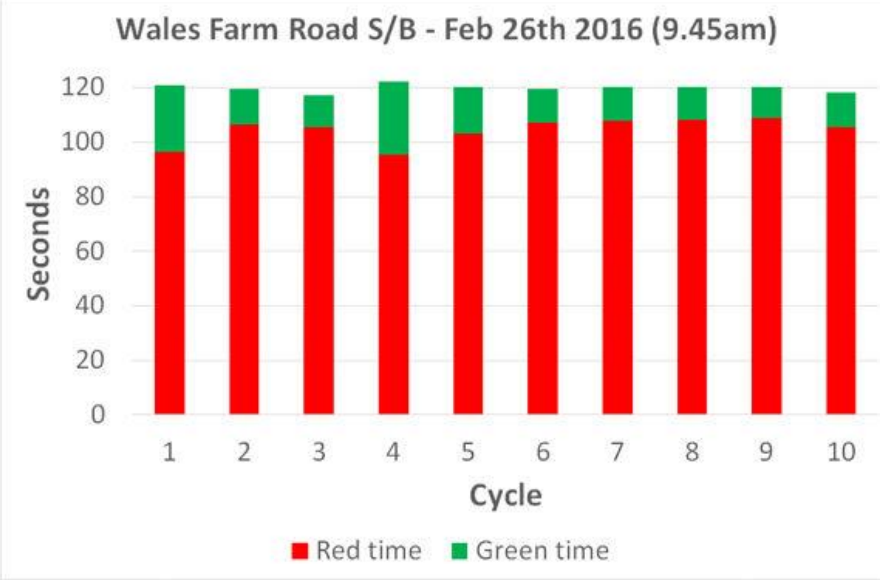


Wales Farm Road southbound sample signal timings

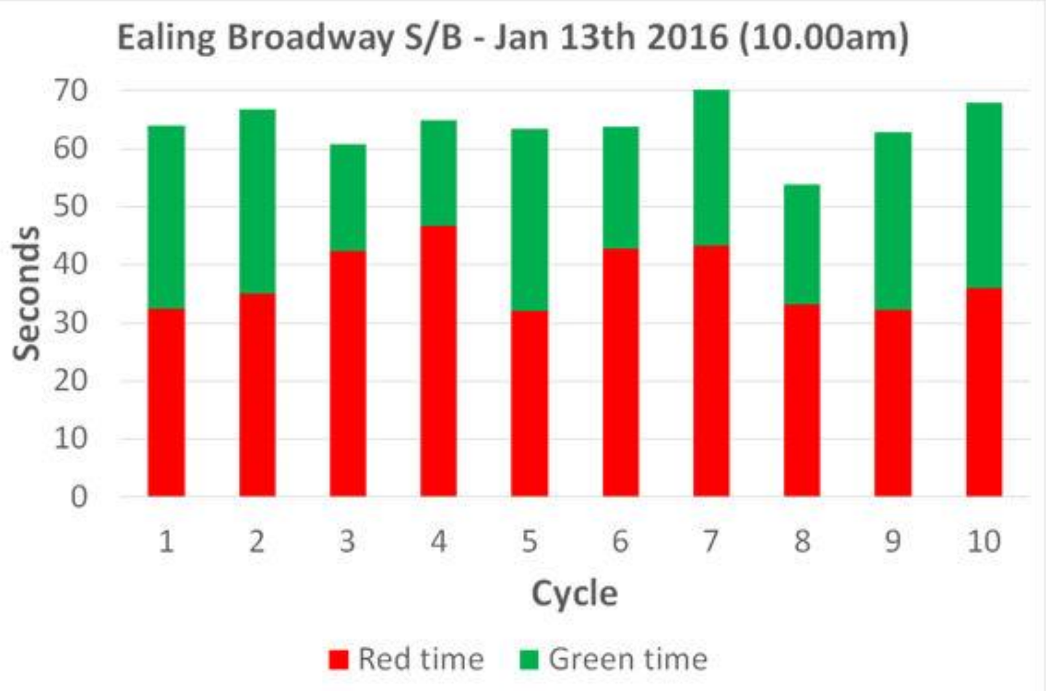


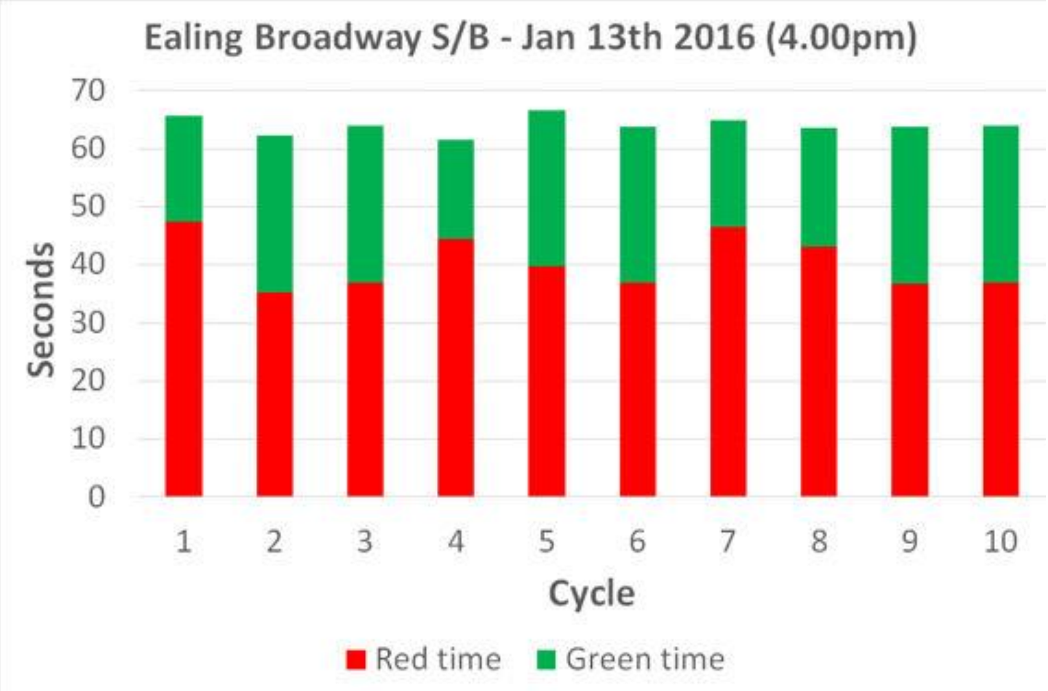






Ealing Broadway southbound sample signal timings





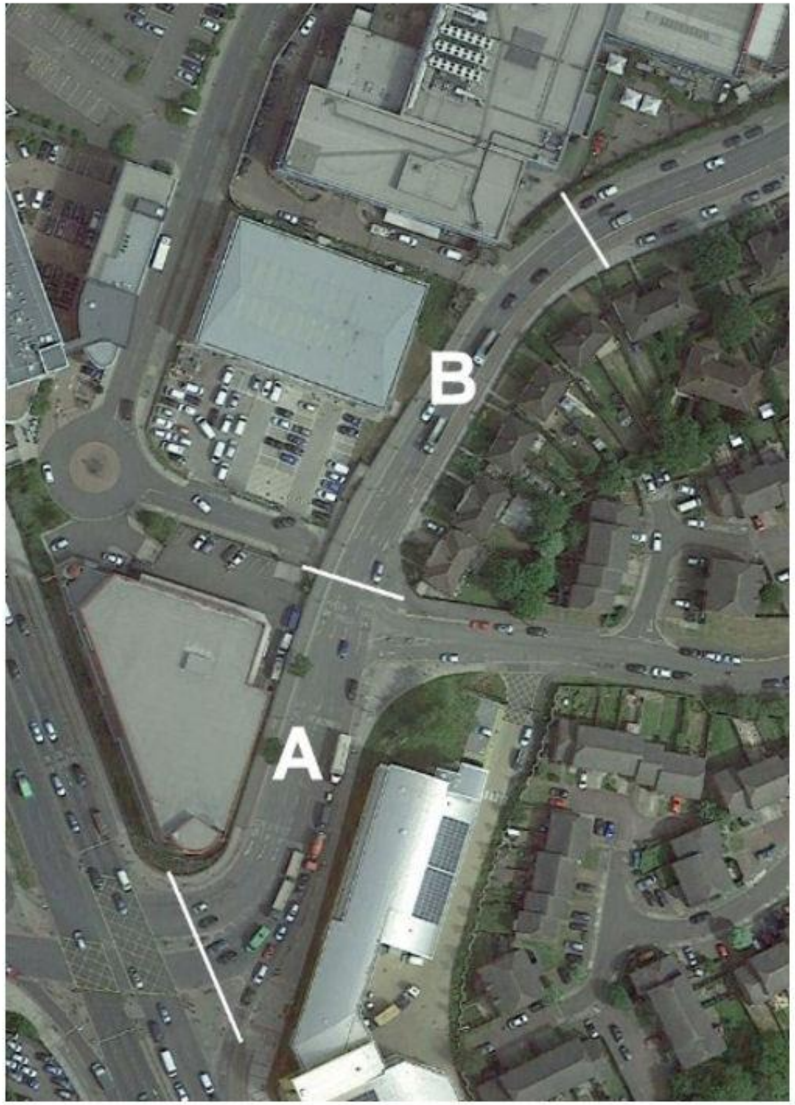
Quantifying vehicle dynamics and stopping

- Data on vehicle stops and delays in the case study areas were derived from instrumented (GPS) vehicle surveys implemented by the author in Ealing in October 2013.
- Multiple runs (circa 30 runs per route and direction, measuring speed and position at a time resolution of 10Hz) during weekdays, within the time period 9.00am to 6.00pm. Broadly representative of daytime weekday conditions.
- For this analysis, each case study location was divided into two 100 metre sections on the approach to the stop line, 0 – 100 m from the stop line (A), and 100 – 200 m from the stop line(B).

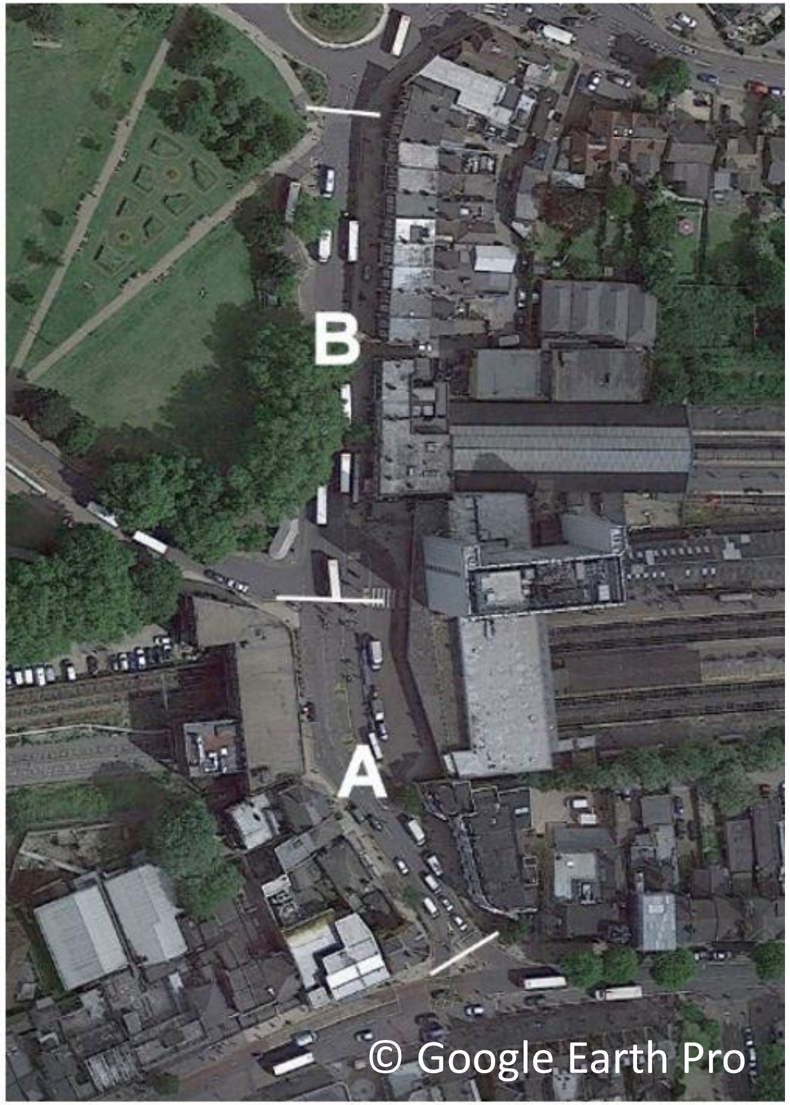
Spatial definition of 100 metre ‘hot spots’ within case study locations

Horn Lane

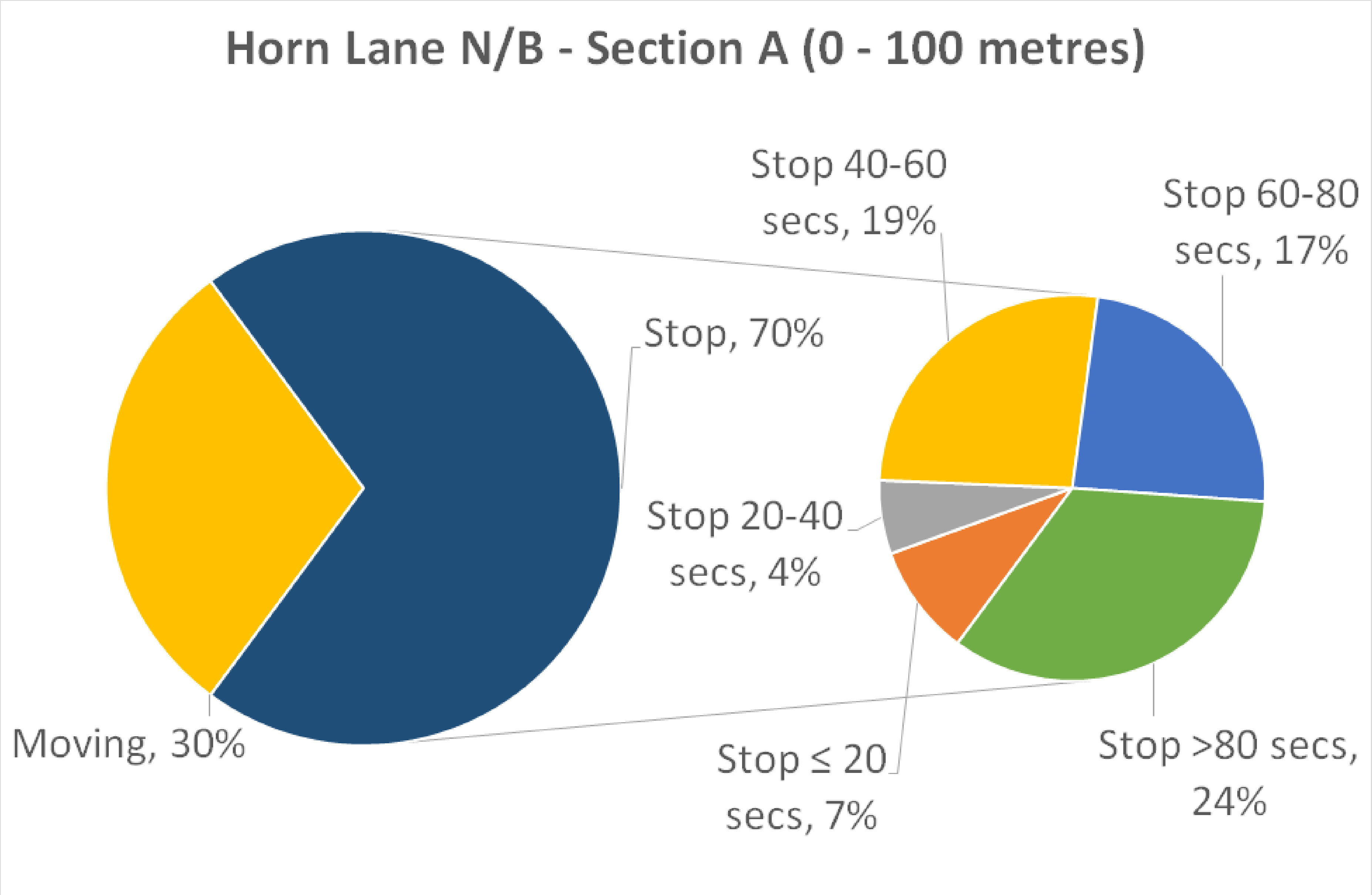
Wales Farm Road



Ealing Broadway



Horn Lane northbound vehicle dynamics and stopping metrics



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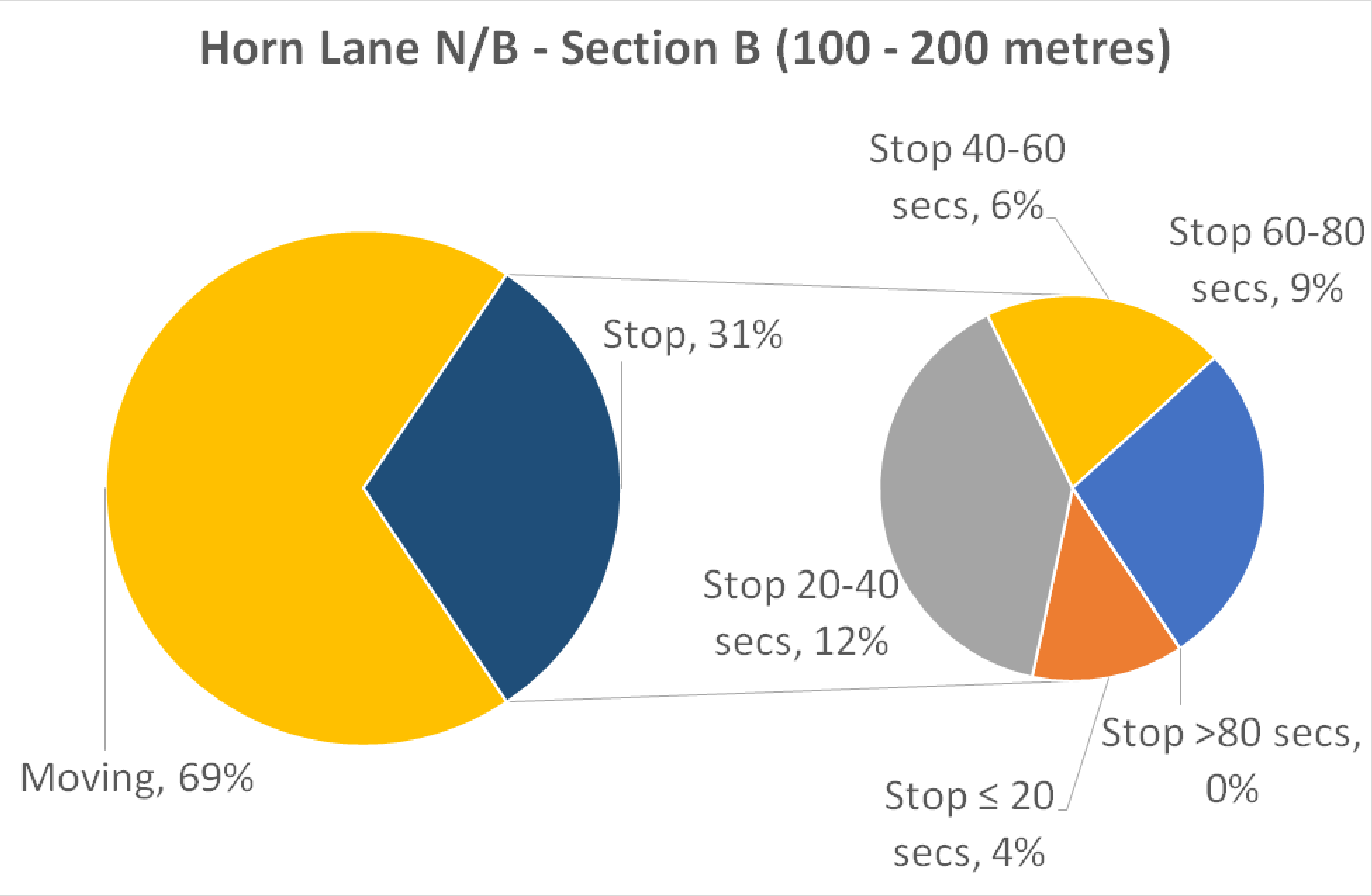
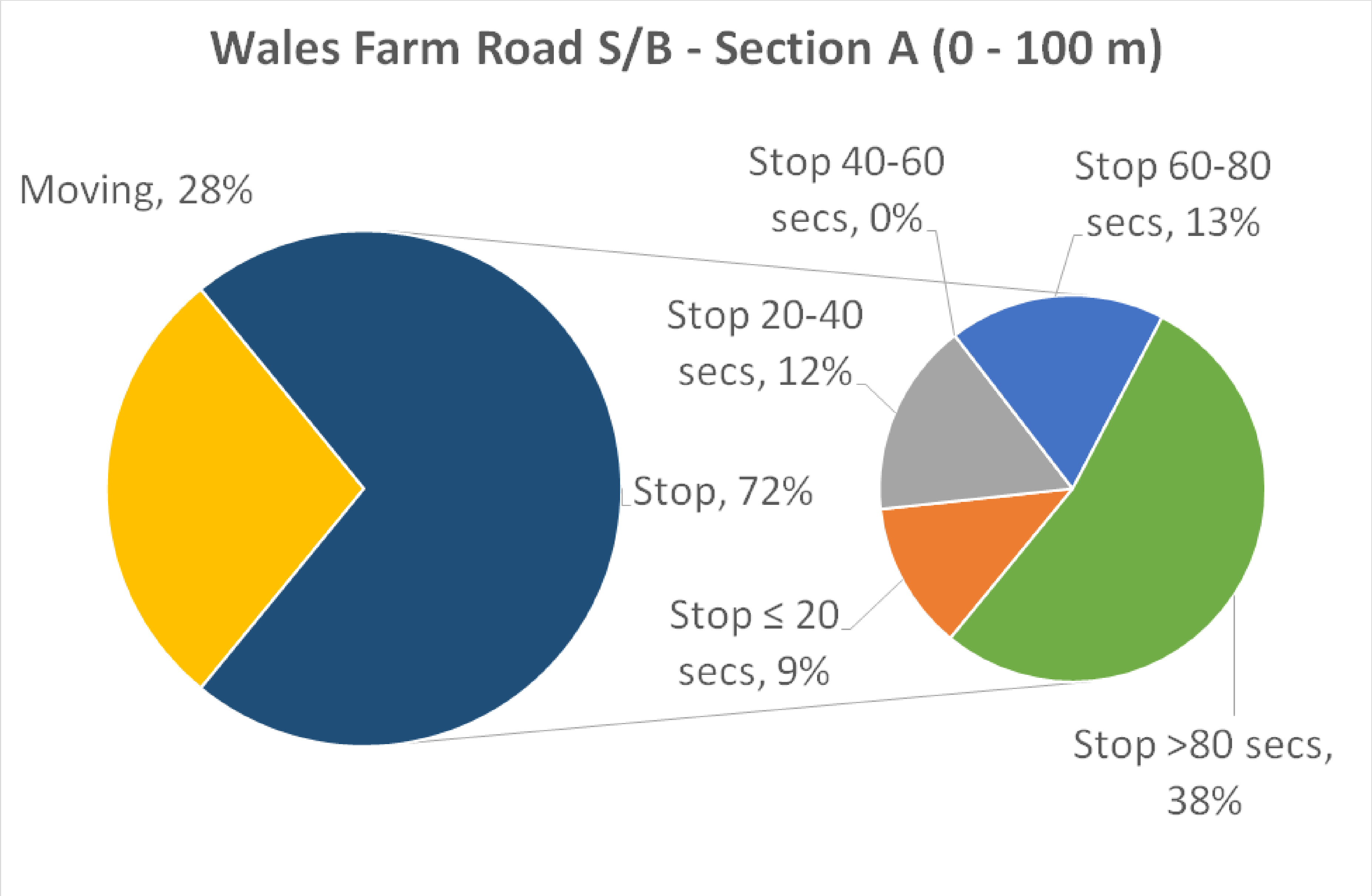


Wales Farm Road southbound vehicle dynamics and stopping metrics



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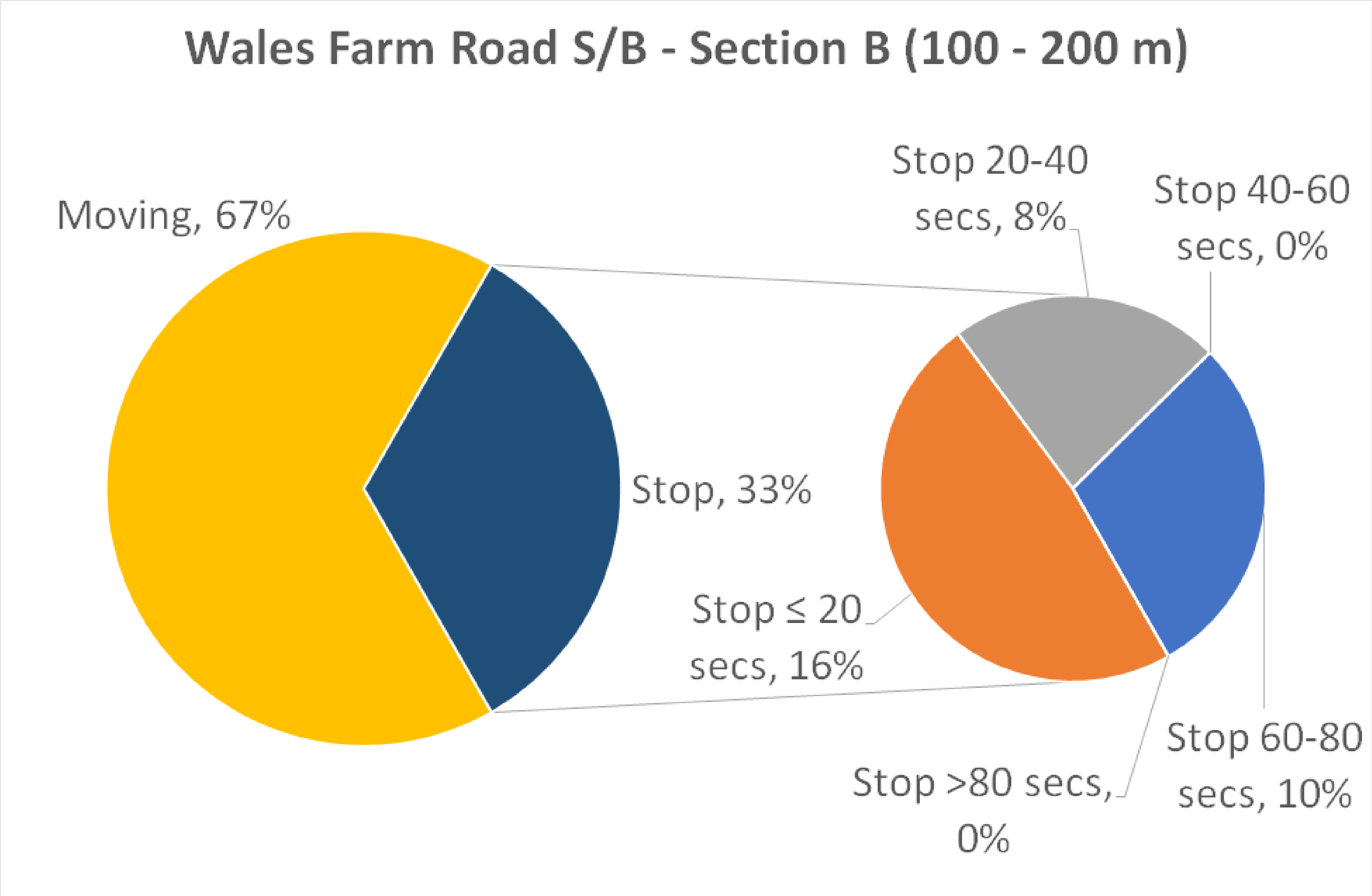

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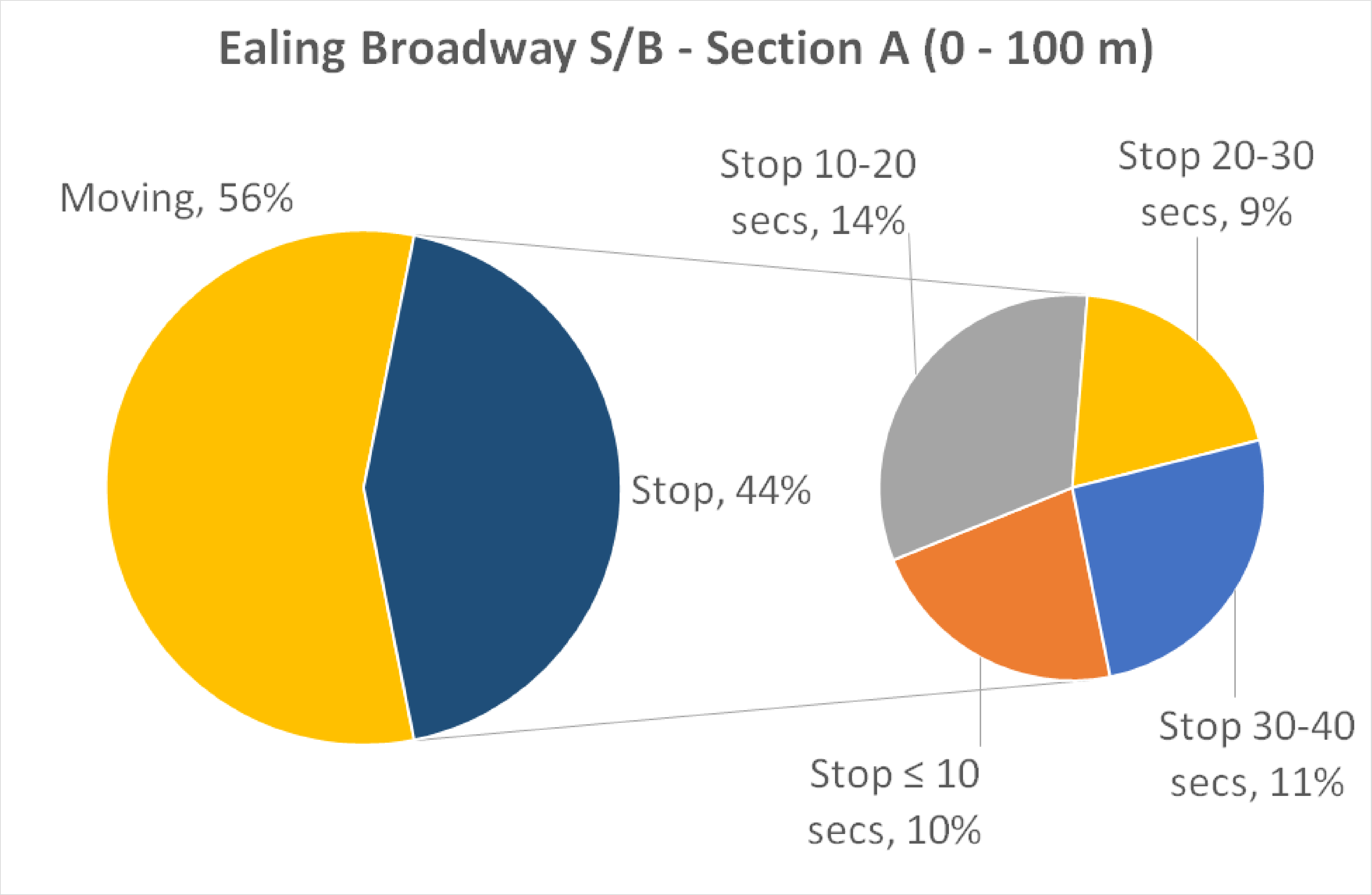
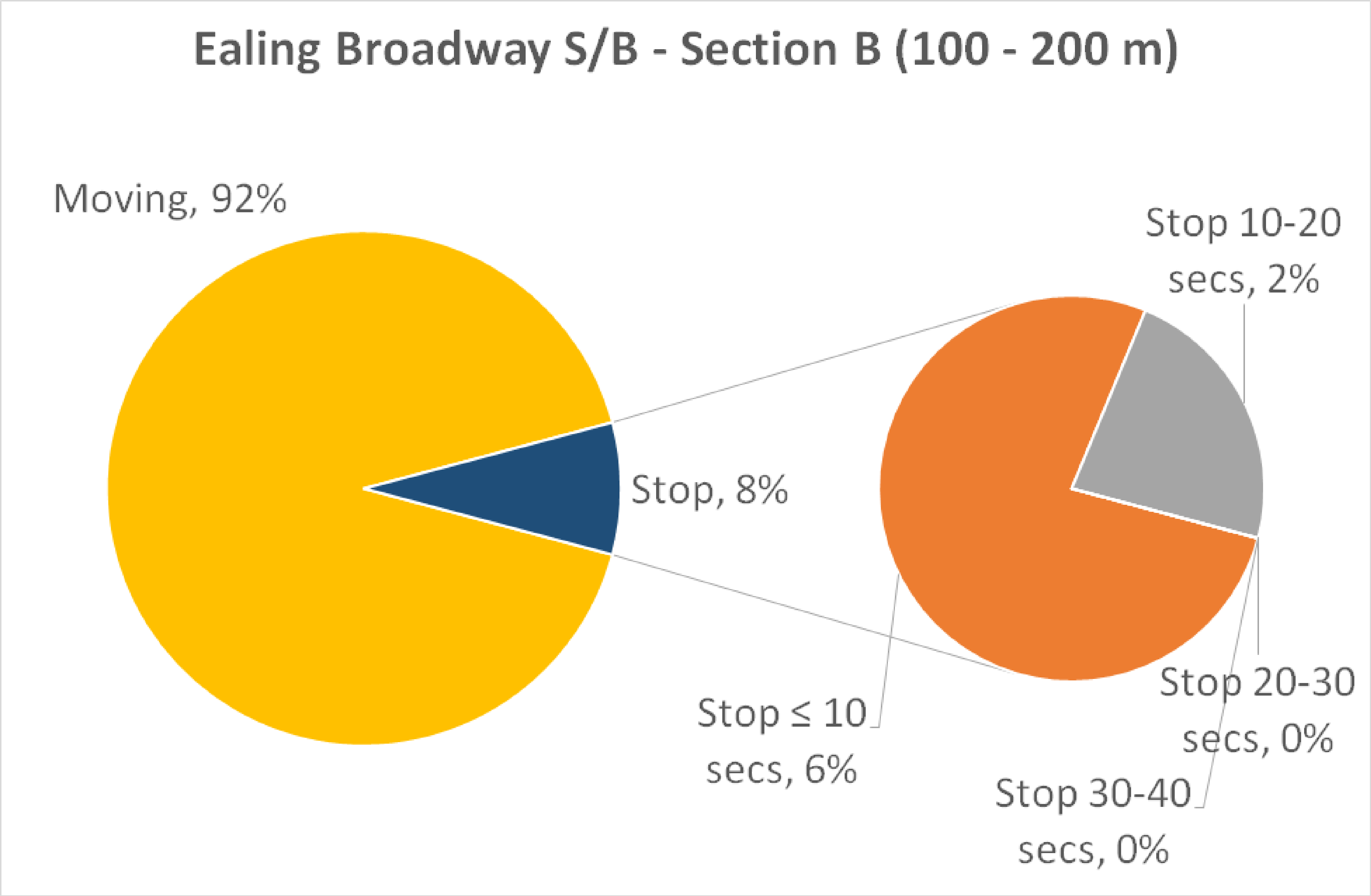


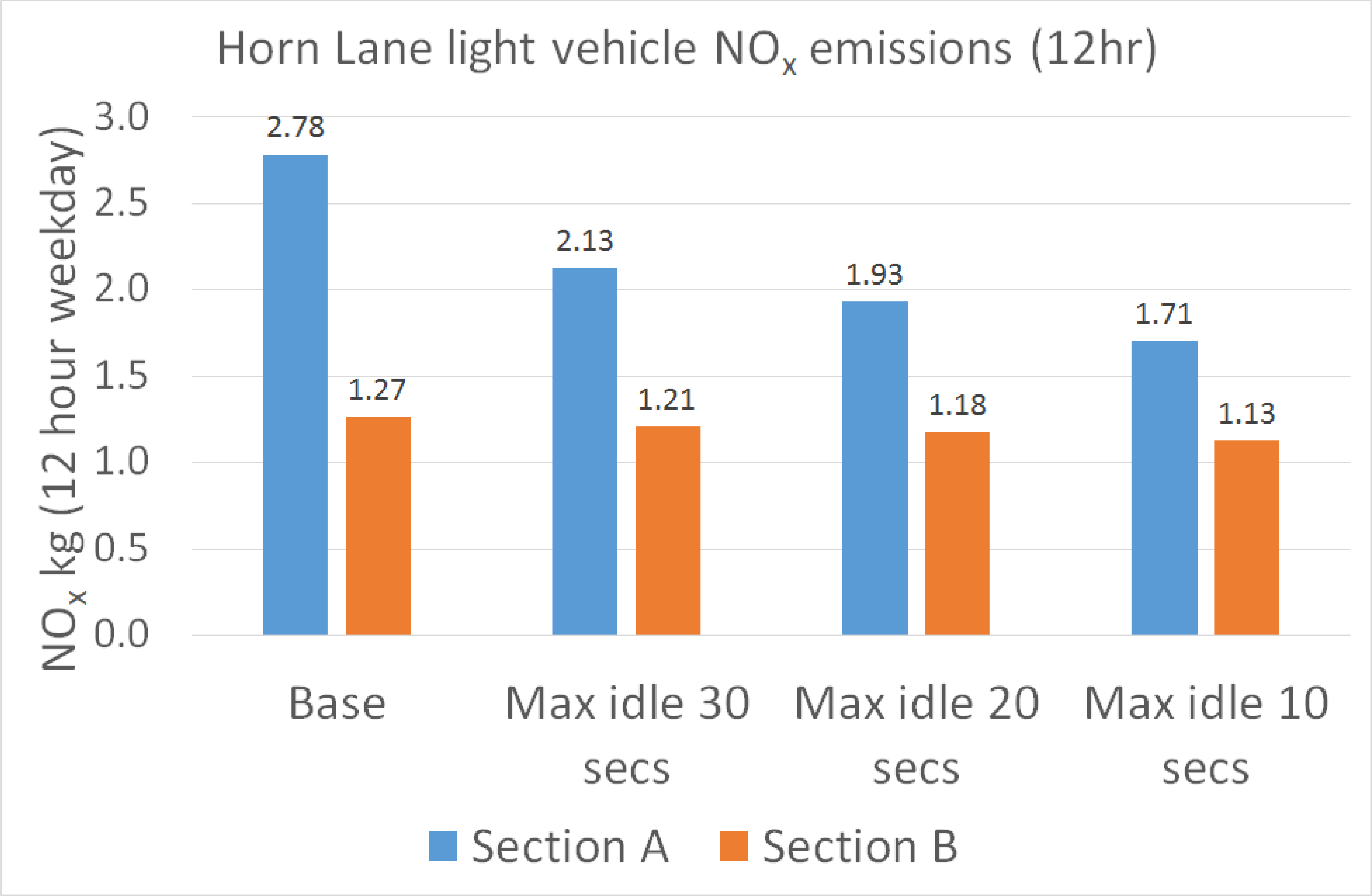
Ealing Broadway southbound vehicle dynamics and stopping metrics



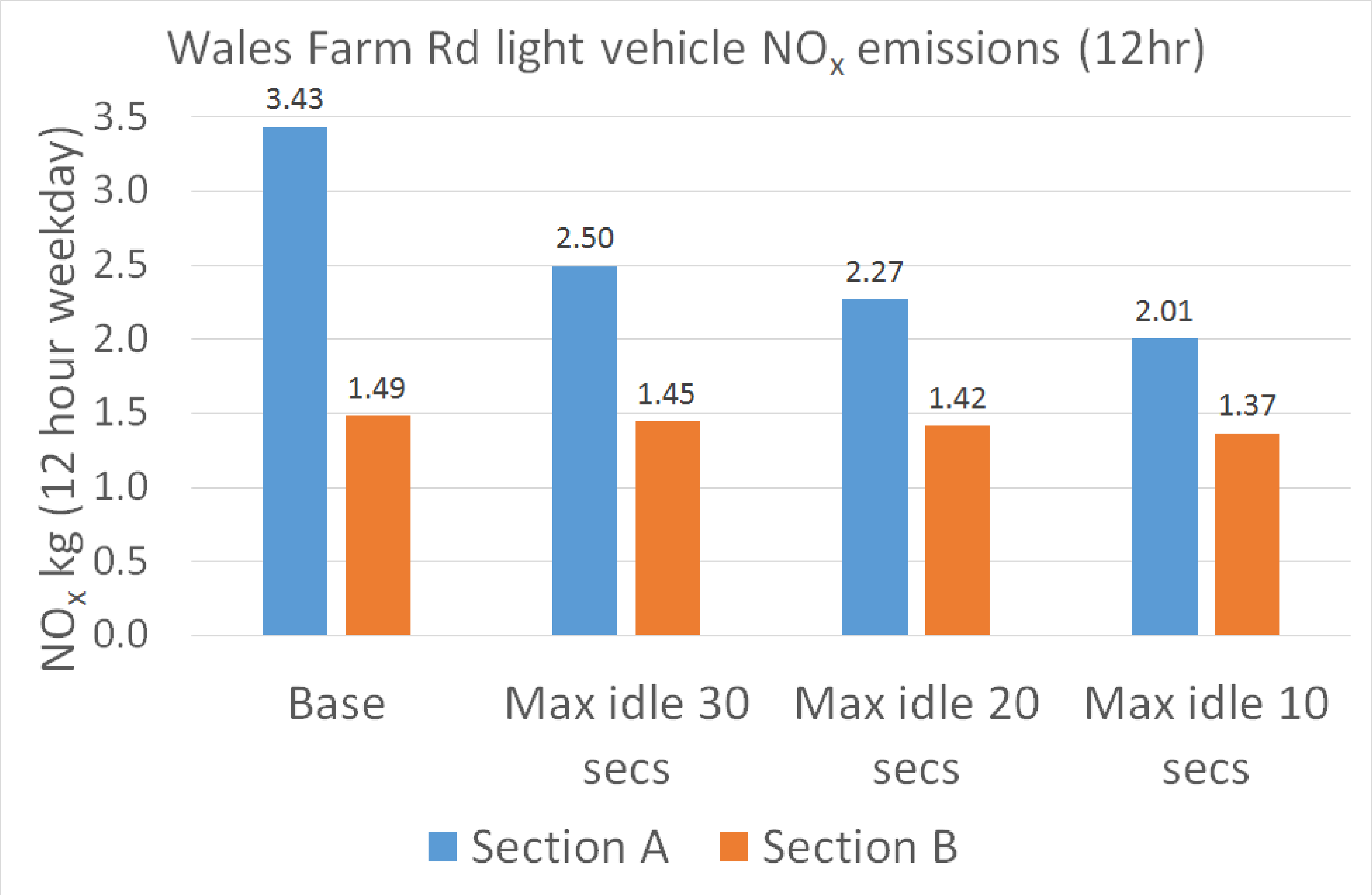
Light vehicle NO_x emissions

- Calculations utilised remote sensing dataset collected in 2012;
- Analysis adopted refined assumptions regarding fuel consumption at idle (informed by additional historical portable emissions monitoring data);
- Assumed 'idealised' scenarios;
  - Base – everybody idles all the time when stationary;
  - Max idle 30 secs – Assumes that if a stop is of duration 30 seconds or more, the engine is switched off for the element of the stop duration in excess of 30 seconds;
  - Max idle 20 seconds…
  - Max idle 10 seconds…

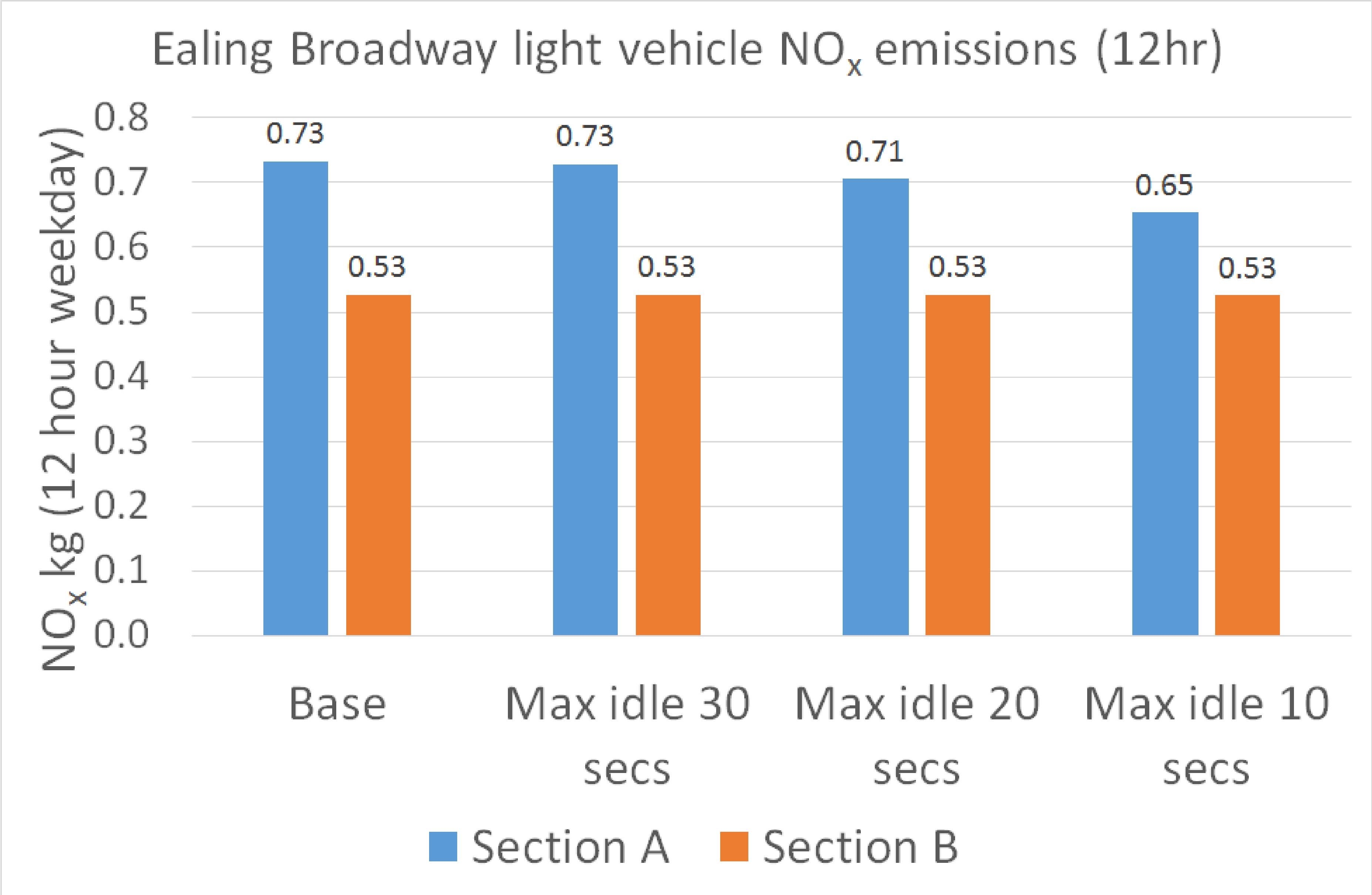
Horn Lane N/B light vehicle NO_x emissions (12 hour)



Wales Farm Road S/B light vehicle NO_x emissions (12 hour)



Ealing Broadway S/B light vehicle NO_x emissions (12 hour)



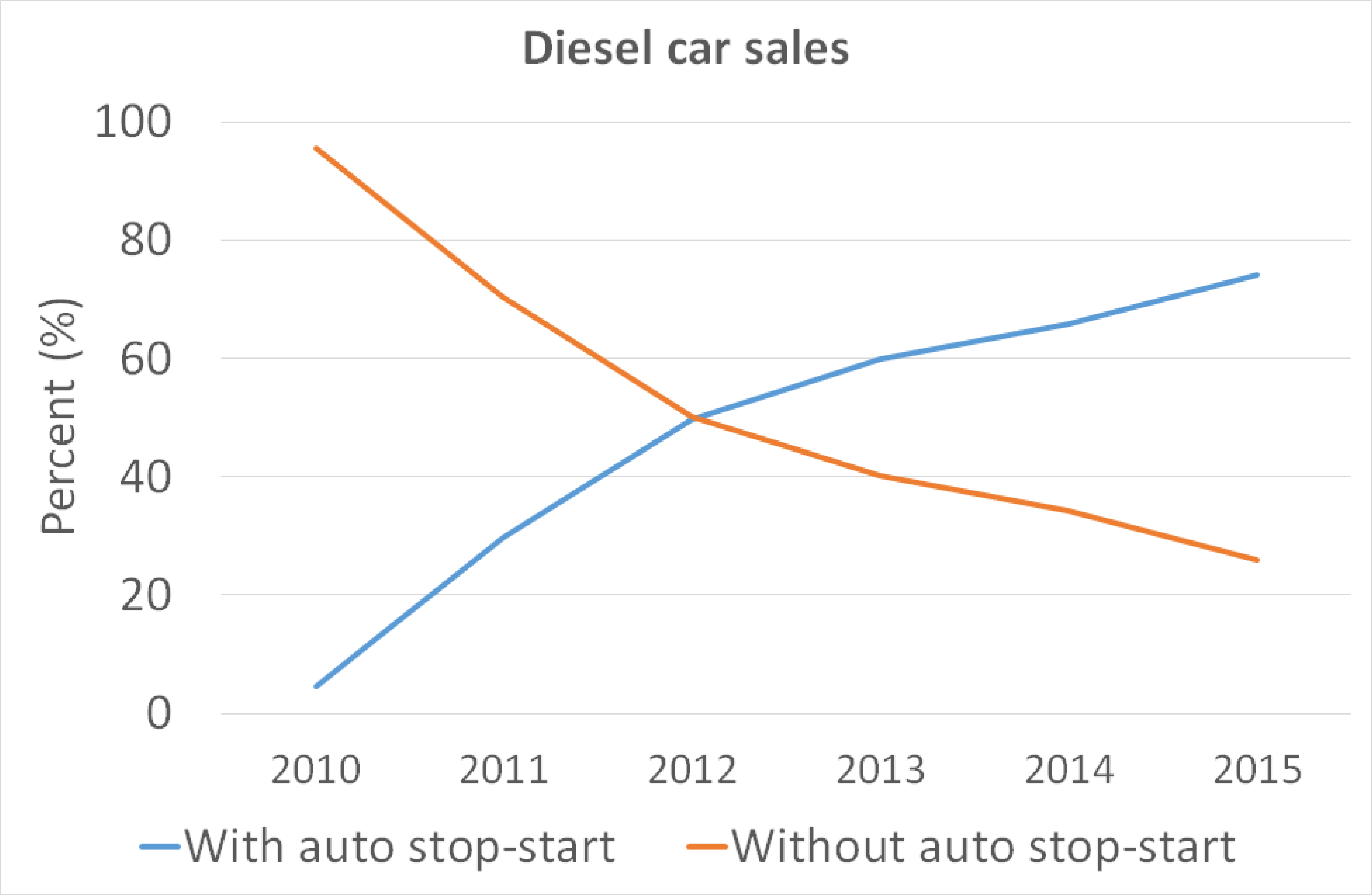
Vehicle technology

It is not proposed that such an active management system be implemented at all traffic signals. Such an active management system would only be applicable to manage vehicle idling at 'hot spot' locations which meet the criteria of high cycle time, low relative green time, and large traffic demand (queuing). This is significant because vehicles not equipped with automated stop/start systems are ***not necessarily designed for repeated stop/start cycles of operation***.

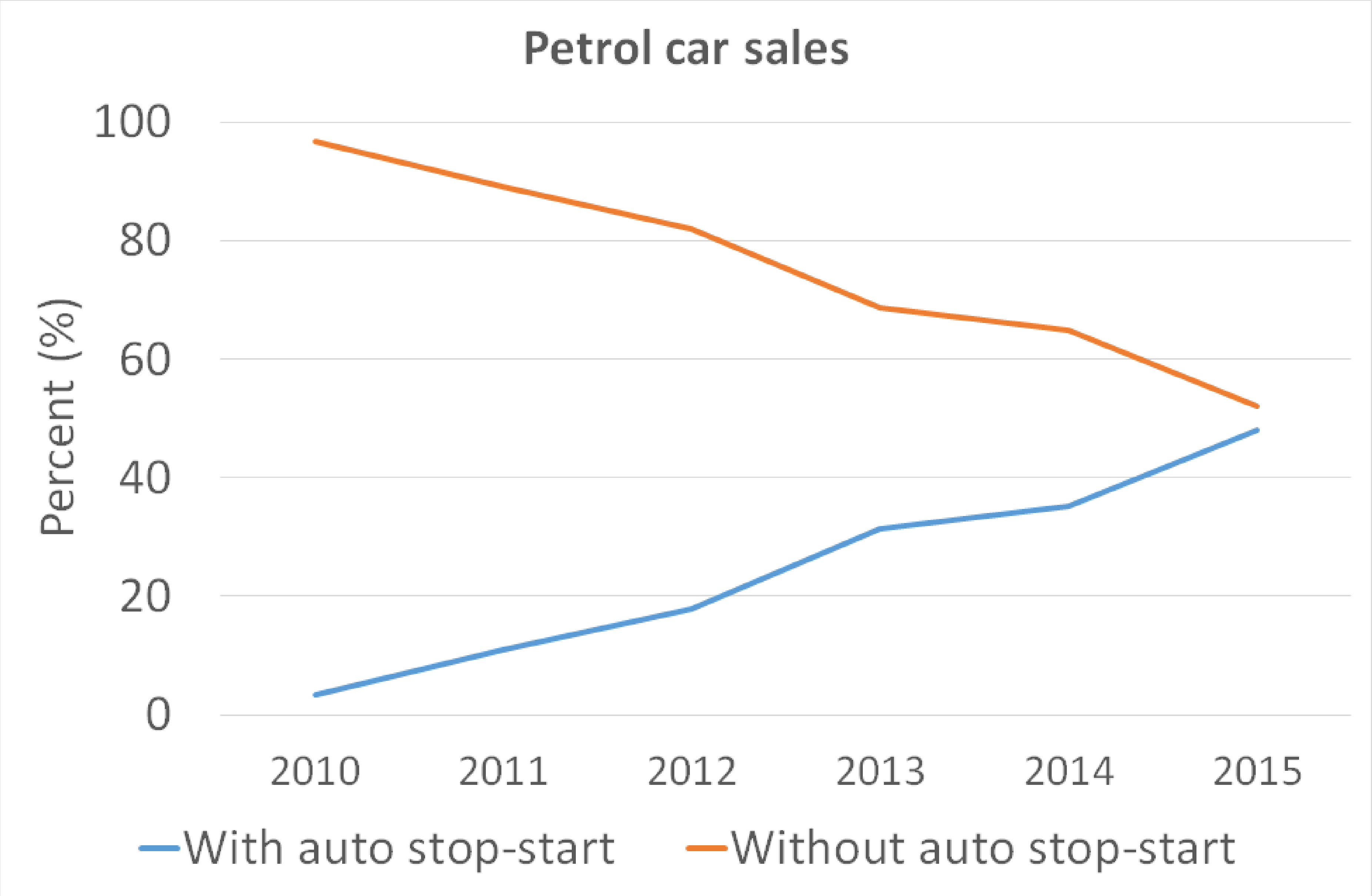
Q. *What is the penetration of automated stop / start systems into the UK light vehicle fleet?*

This study implemented a postal survey of light vehicle manufacturers.

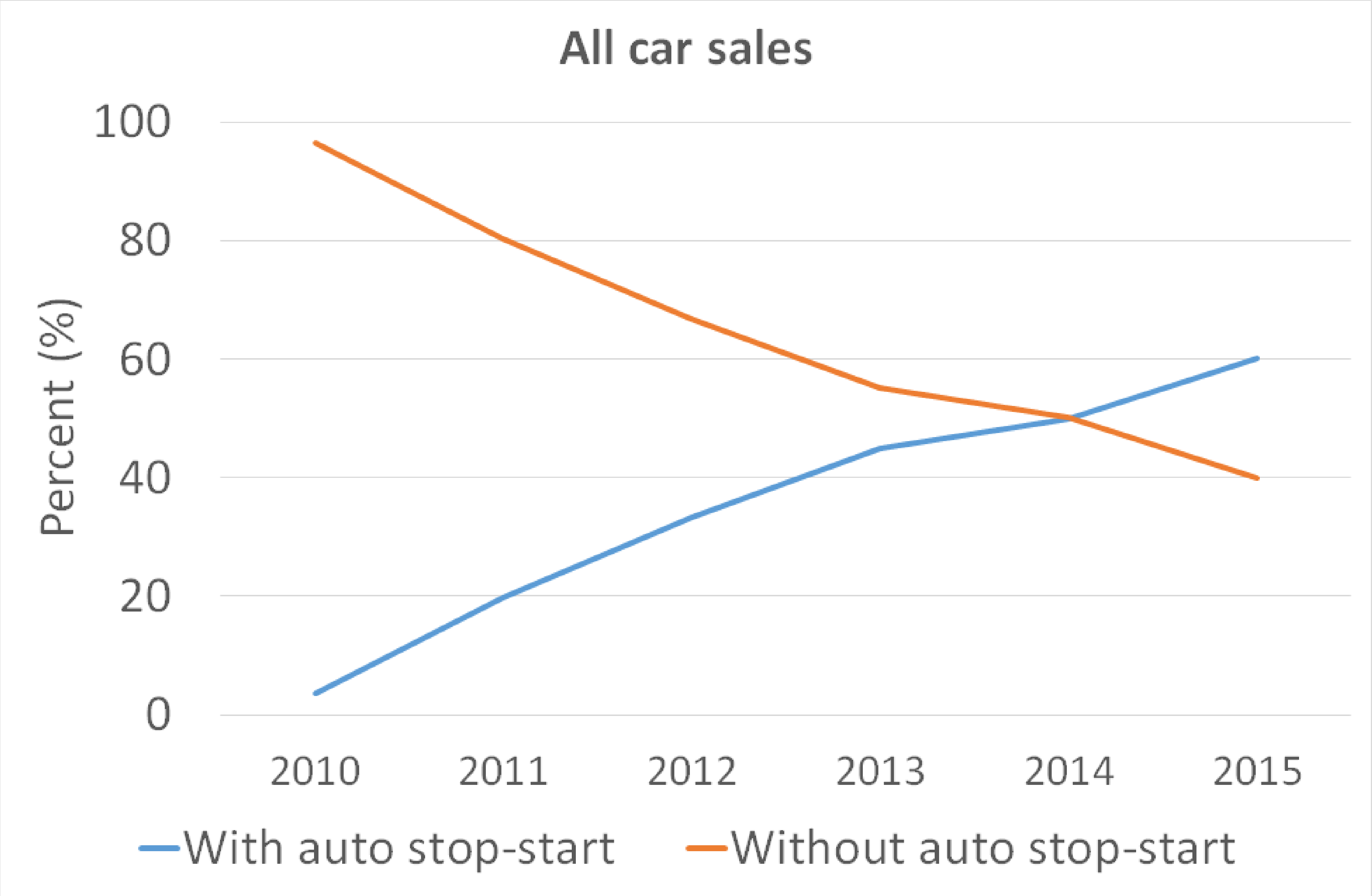
Penetration of auto stop / start technology into the diesel car fleet



Penetration of auto stop / start technology into the petrol car fleet



Penetration of auto stop / start technology into the car fleet



Limitations and uncertainty

- Need to validate exhaust emissions assumptions utilising data from explicit stop / start cycles of varying duration (laboratory or PEMS measurements?). The existing remote sensing data set is not definitive. Transient emissions ‘spikes’ may occur during cycles which might undermine calculated benefits;
- Need to refine fuel consumption assumptions, particularly at idle;
- Need to refine exhaust emissions assumptions, particularly for Euro 6;
- Need to extend the analysis and research to heavy vehicles and buses;
- Uncertainty regarding how drivers with automated stop / start systems actually use them (if at all);
- Need to address how best to implement such a system within an adaptive traffic control system such as SCOOT.

Acknowledgements

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- Vehicle manufacturers for data supplied

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