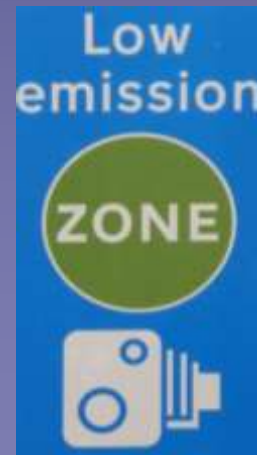


# Investigation of Air Pollution Standing Conference - 2017



## Sensor Based Air Quality Modelling Techniques

Drew Hill  
Transport Scotland



HIGH AIR POLLUTION  
IN CITY CENTRE  
CONSIDER P&R

# Sensor Based Air Quality Modelling Techniques

- 1 Background
- 2 Purpose and objectives
- 3 Equipment choice
- 4 On site work
- 5 Data analysis
- 6 Findings and reporting
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- 8 Next Steps



## Collaborative Sensor Rotation Programme (CSRP)

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Project Summary



Prepared for Transport Scotland  
by IBI Group  
January 2014

COMMISSIONER (2014-2019)

**Violeta Bulc**

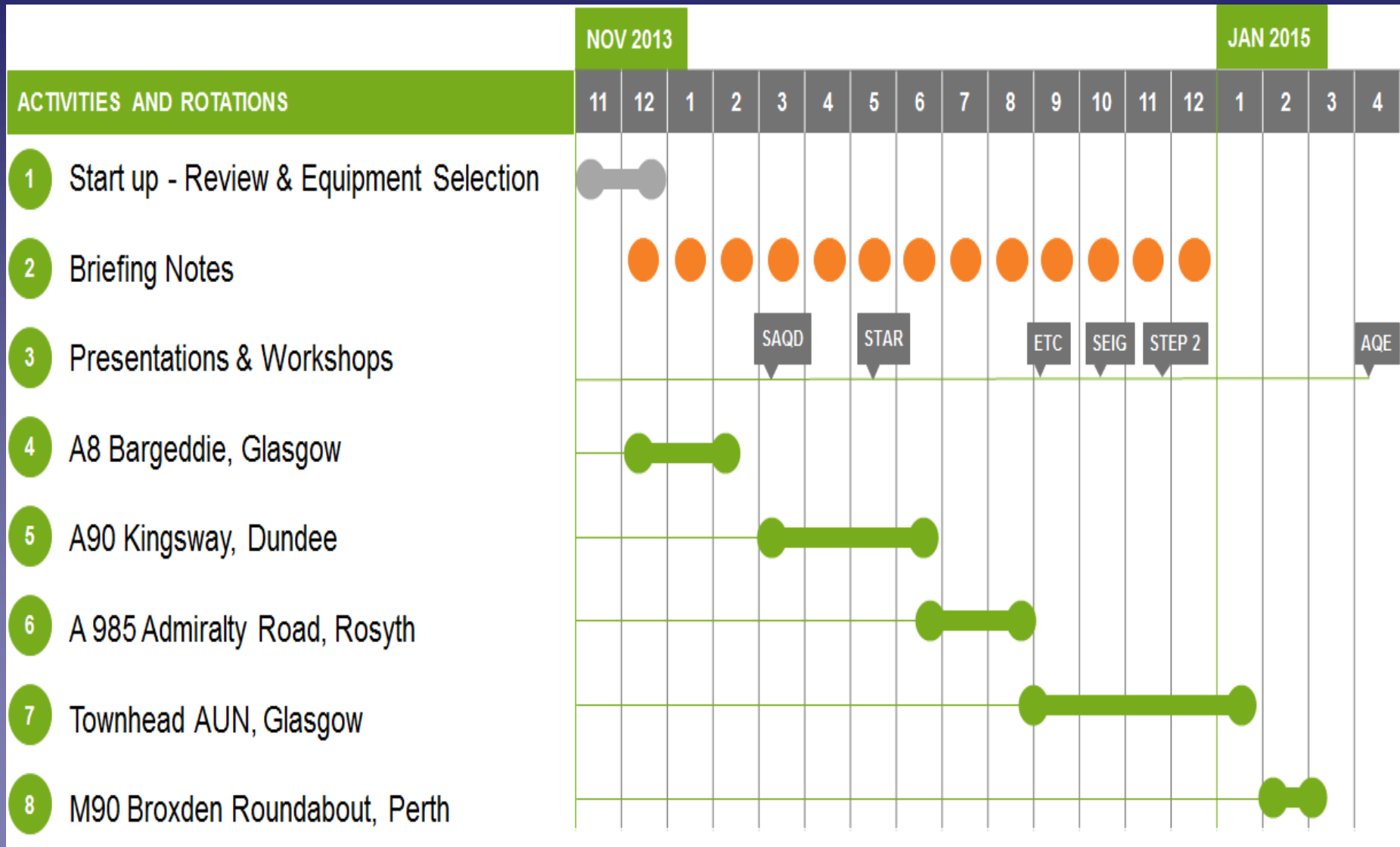
Transport



.....digital technologies are one, if not the strongest, drivers and enablers of the pressing need, to make transport safer, more efficient and sustainable.....

European Commission  
Commission européenne

# Background



# Background – Key Partners



Organisation	Details	Project Role
Envirologger	AQMesh supplier	Supplier
IBI Group	Consultant	Transport Scotland ITS Test Bed, commissioning, traffic data and equipment support, ITS supplier liaison
Local Authorities	Rotation locations	Data, coordination and air quality background
Scottish Government	Air quality policy	Contributory funding and link to wider policy
Scottish Transport Emissions Partnership (STEP)	Air quality technical group	Sharing information
SEPA	Agency	Correlation, technical input and support
TDC Systems	HI-TRAC PM and EMOTE supplier	Supplier
Transport Scotland	Scottish Government agency	Leadership, coordination and defining of objectives
University of Strathclyde	Academic institution	Defining sensor metrics, project review and settling of wider context



# Purpose and Objectives

CSRP SHORT  
TERM OBJECTIVES

**MEASURE**  
roadside air quality  
levels & to link these to  
flow and fleet  
characteristics

**IDENTIFY**  
the most effective,  
economical & low  
maintenance air quality  
sensor system

**DEFINE**  
the most relevant air  
quality & traffic related  
metrics

**COLLABORATION**  
to build a collaborative  
AQM community

**BASELINE**  
create a baseline for the  
appraisal &  
development AQM  
actions, such as the  
creation of ITS solutions  
that actively manage air  
& noise pollution

CSRP LONG  
TERM OBJECTIVES

**TOOL  
ENHANCEMENT**  
to provide suggestions  
for air quality  
improvements to  
Transport Scotland &  
ITS tools

**EVIDENCE**  
of fleet change & to  
compare DMRB-based  
Environmental  
Statement predictions of  
air quality with findings  
on site

ITS tools  
& environmental  
management

on site

## Equipment choice

### AQ Mesh (2)

- Battery operated devices with electrochemical sensors which measure NO, NO<sub>2</sub>, SO<sub>2</sub>, CO and O<sub>3</sub> gases



### Hi Trac (2)

- A roadside particle monitor that measures PM<sub>10</sub>, PM<sub>2.5</sub>, or Total Suspended Particulate (TSP) concentration at roadside locations.



## On site work

- A8, Bargeddie, Glasgow
- A90, Kingsway, Dundee
- A985, Admiralty Road, Rosyth
- Townhead AURN Site, Glasgow
- M90, Broxden Roundabout

## Details

- Sites chosen on basis of road type, traffic flows, and stakeholder participation.
- Aim for three month rotation at each site.
- Capture traffic, meteorological, and air quality data.
- Meeting and engagement with Local Authorities and other partners in the area.



## Field Correlation

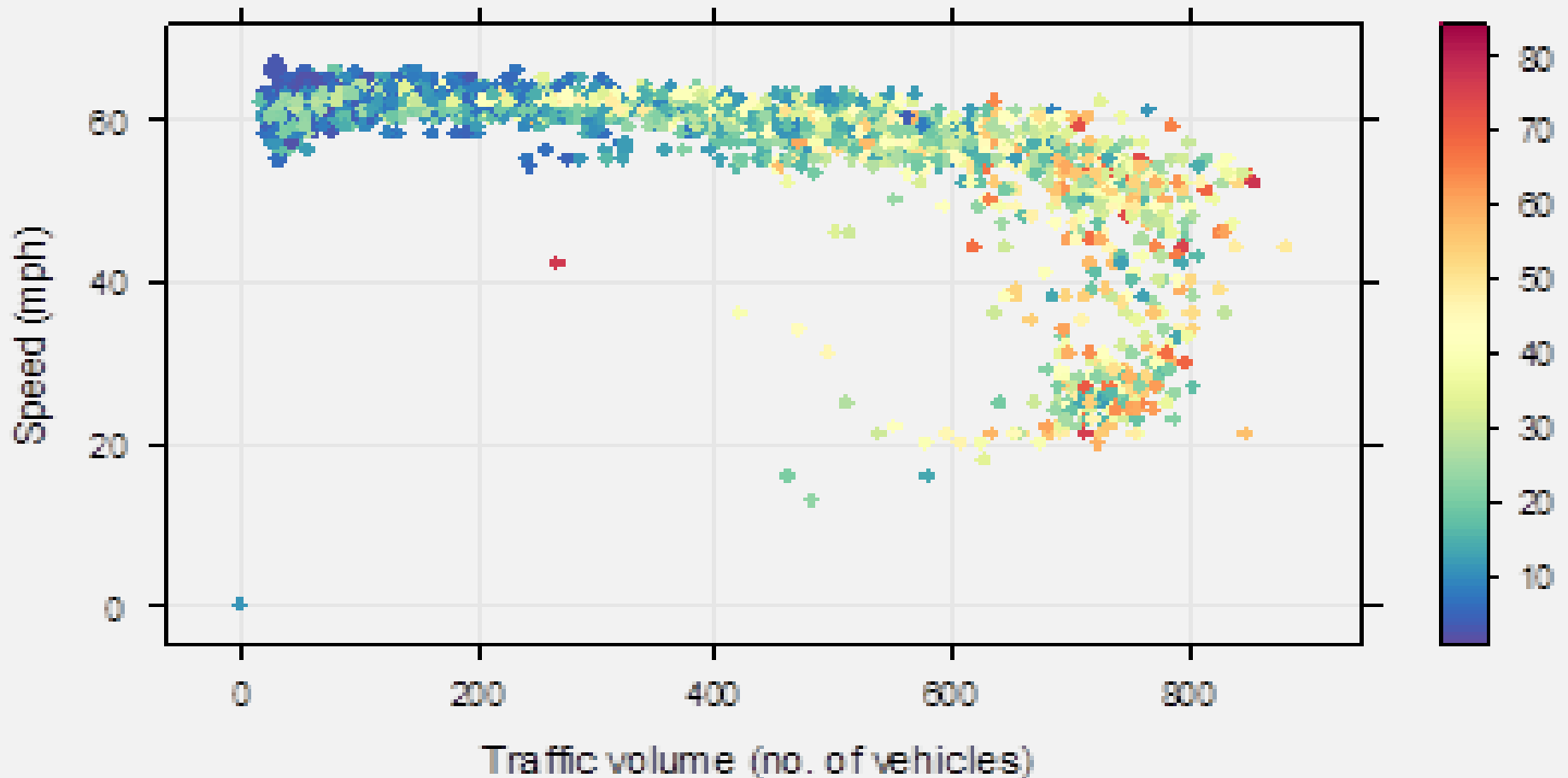
- Reference equipment from SEPA incident response trailer.
- Compared results with IOM project using AQMesh.
- Detailed work at Bargeddie comparing with University of Strathclyde equipment.



# Data analysis

## Bargeddie NO<sub>2</sub> data and traffic parameters

Traffic flow / speed curve by NO<sub>2</sub> (15 minute data)



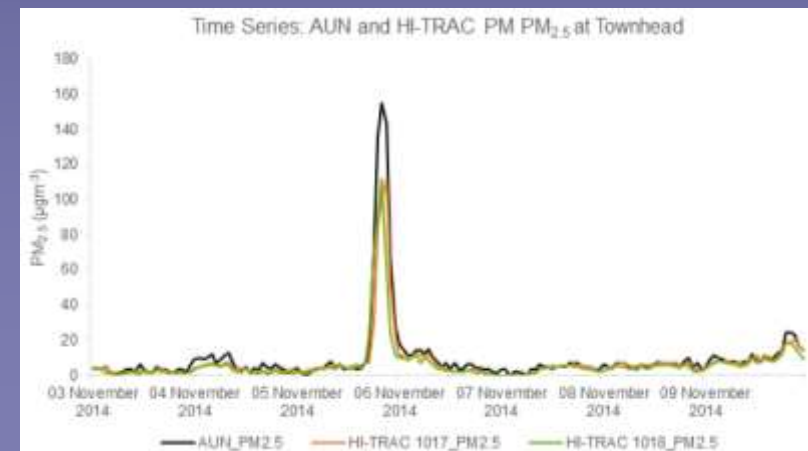
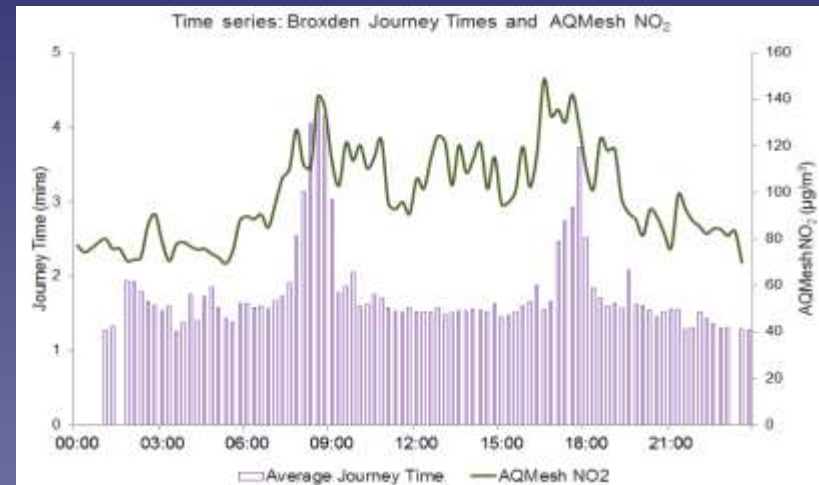
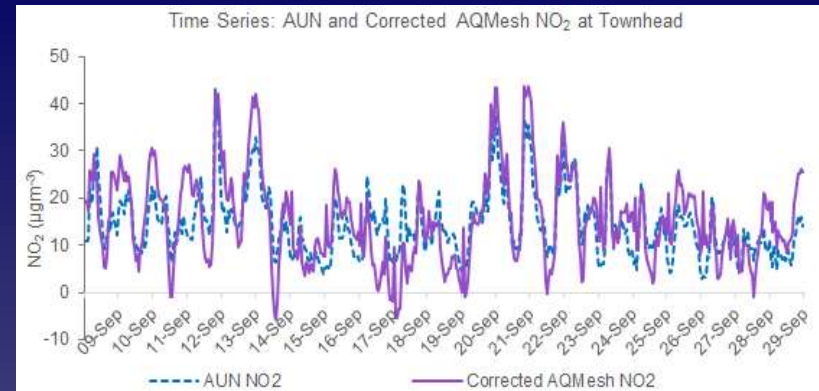
# Data analysis

## Some key points

Good AURN and AQMesh correlation for NO<sub>2</sub> at Townhead

Intuitive relationship between journey time and AQMesh at Broxden

HITRac and AURN good PM correlation at Townhead

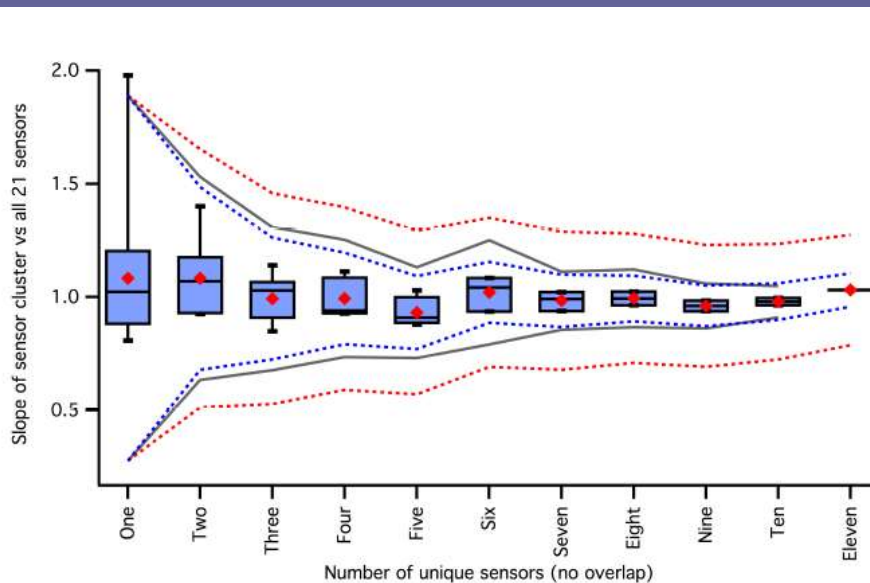


# Findings and reporting

## General

- Not for replacement of reference equipment.
- No “Fit and Forget”.
- Good for rapid deployment.
- Can provide useful information to fill in gaps, and add to model forecasts, interpolations, or predictions from land-use models.
- Could be beneficial in those urban locations that are known to be poorly forecast because of topography.
- Key reports available online.

But Faraday Discussions paper (Lewis, et al), notes.....full analytical evaluation of sensor performance is required using both real-world pollutant abundances *and* in the presence of a full suite of realistic co-pollutants and interferences....



## Findings and reporting

## AQ Mesh

### Strength

- Good provider support on maintenance and encouragement of supply chain understanding.
- Continuous improvement in the technology.
- Opportunity for connection in wide data array.
- Rapid deployment possible with immediate use if required.

### Less Strong

- Occasional sensor failure.
- Data trended well but lacked good correlation to reference equipment.
- Full algorithms locked.
- User intelligence required for maintenance and interpretation.
- Unit to unit variation existed.



## Findings and reporting

## HI Trac

### Strength

- Well-correlated, continuous, near real-time data when compared to units based on gravimetric measurements.
- Durable equipment.

### Less Strong

- Requires mains power.
- Repair required a “back to base” approach.





## Research Benefits

## Specific

### Ford Road Bridge Closure Deployment Conclusions

- Equipment useful to better understand how air quality can change in relation to altering traffic conditions.
- With future hardware and software development will potentially be an additional data source to allow drivers to make informed decisions.
- Data suggested no significant increase in levels of NO<sub>2</sub> or PM<sub>2.5</sub> concentrations at the Longannet Roundabout for the period of the FRB closure and that no limits were exceeded.
- Demonstrated the ability to rapidly deploy air quality monitoring equipment, allowing real time monitoring of air quality, and provision of valuable information which could inform the selection and operation of alternative routes.



Report

### Collaborative Sensor Rotation Programme: Kincardine – Forth Road Bridge Closure



Prepared for Transport Scotland  
by IBI Group  
22 December 2016

# Research Benefits

## General

EDAR

Academic links

ITS UK

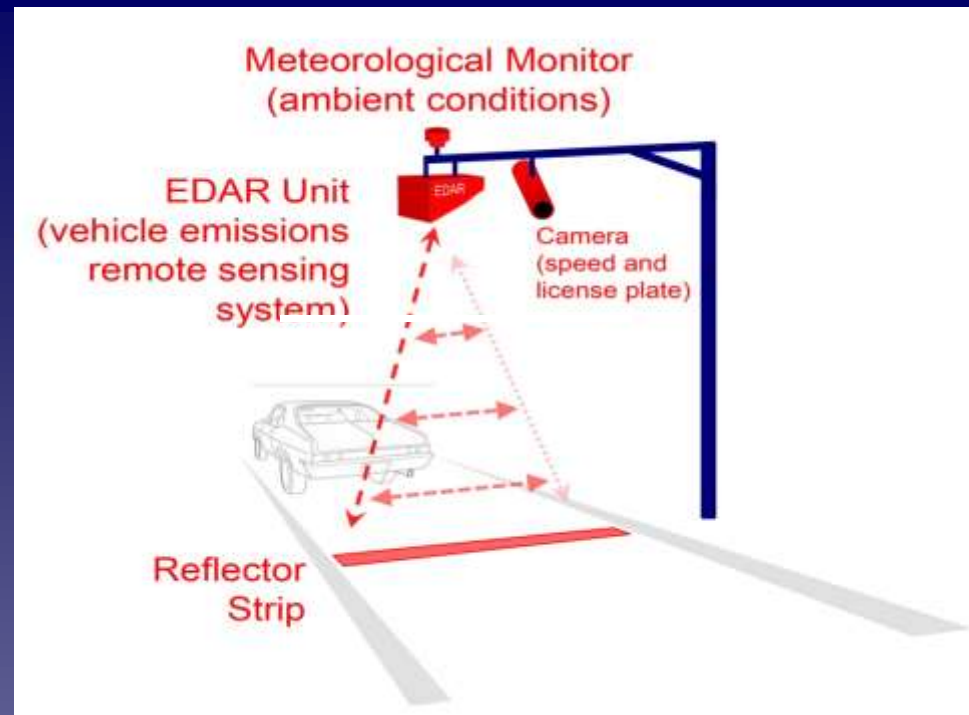
QCumber

Future

Research Bids

Links to NMF

LEZ Informing.



A range of projects including uTRAQ, Carbotraff, and others are developing a “Playbook” of transport interventions based on a range of data sources (traffic, environmental, and low cost sensors) to improve air quality.

Business led solutions are seeking to capture this work in industry strength solutions.

## Acknowledgements

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The key strategic partners.

Various collaborators, particularly the Local Authorities involved for their openness in describing their work and findings to date

Equipment retailers for their explanation of the operation of the equipment, and the working together on opportunities for development.

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