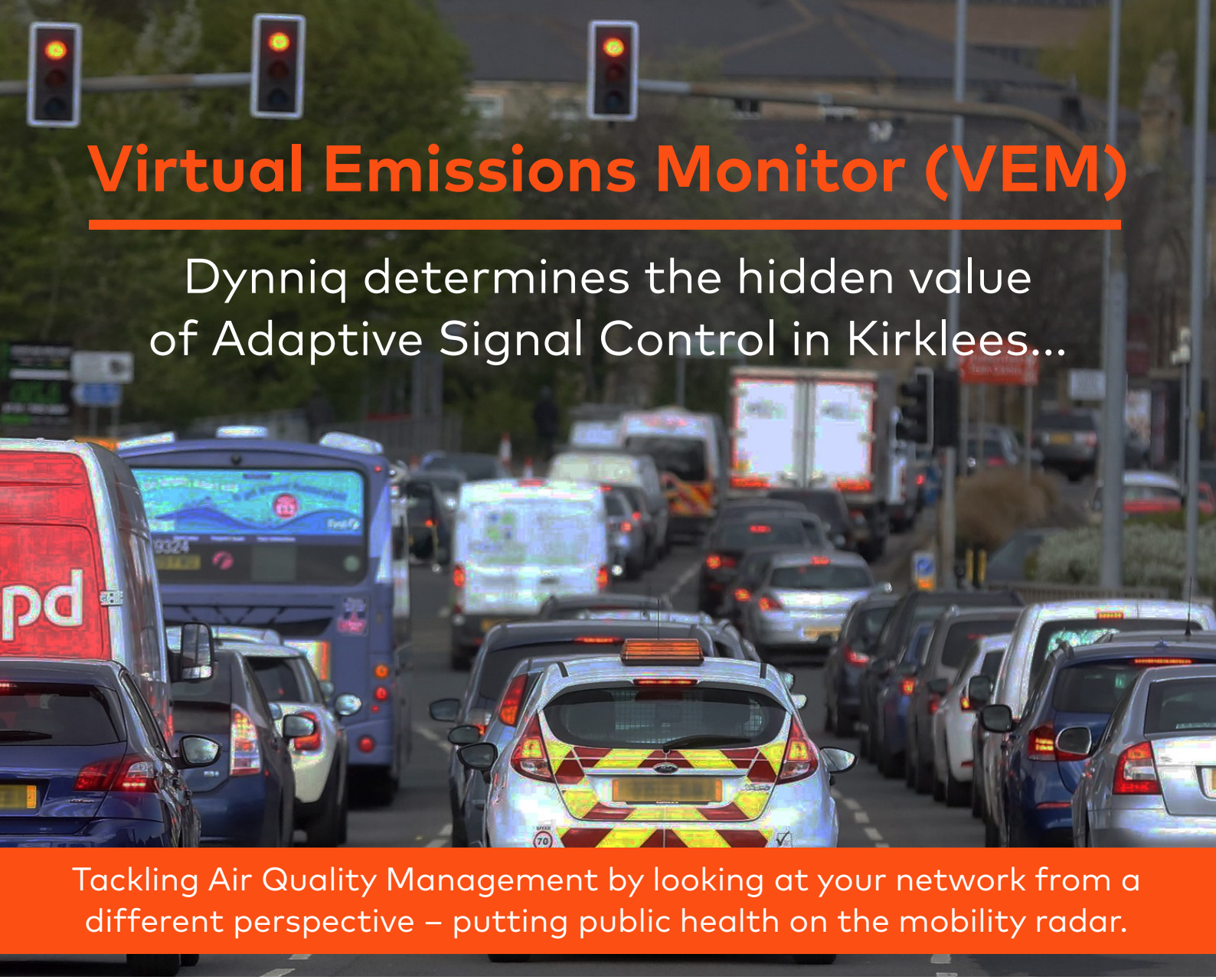


Virtual Emissions Monitor (VEM)

Dynniq determines the hidden value of Adaptive Signal Control in Kirklees...

Tackling Air Quality Management by looking at your network from a different perspective – putting public health on the mobility radar.

Background

With Air Quality gradually worsening and no viable solutions, Dynniq seek to solve the problem by taking a different seat in Air Quality Management (AQM). Dynniq have recognised that Air Quality is simply a symptom and not the cause. Typically local authorities are using Air Quality monitors to affect signals, which is simply treating the symptoms.

Dynniq uses a bespoke software solution, Virtual Emissions Monitor (VEM), to accurately identify causes through the measurement of vehicle emissions without additional infrastructure. Kirklees County Council adopted the system to determine the effect of Adaptive Signal Control on emissions and the economic impact. The initial project work showed a 31% reduction in emissions when SCOOT was used over fixed time signals. But the real benefit of having the VEM is that it is able to continually capture and report the Virtual Emissions Data, meaning any subsequent changes made, or fine tuning of the control strategies or SCOOT plans can be immediately observed and verified.

dynniq energising mobility

Kirklees COUNCIL

The Customer Challenge

Deteriorating Air Quality is a growing concern for local authorities throughout the UK. Working with the EU, the UK established 43 assessment zones where commitments were made to improve Air Quality by 2010. The UK failed to reach the agreed targets in 40 of 43 zones, resulting in legal proceedings. It is the opinion of the House of Commons that the EU targets should be regarded as minimum requirement. Furthermore, local authorities have a duty of care to their constituents to provide a safe living environment, which includes the avoidance/ reduction of emissions where possible.

The difficulty when trying to tackle Air Quality issues is the complex relationship between source of pollution and measured Air Quality. Couple this with the relatively high cost of a measurement device and you find yourself generally no clearer as to the source of problem; how to solve the problem; or how to measure the impact of the changes that have been made.

In terms of an urbanised area, one of the main sources of pollutants is cars and commercial vehicles. However the main factor in determining the local Air Quality is atmospheric conditions, followed by topological arrangement. It is perfectly conceivable that a on a highly congested day, with the correct weather conditions, the locality will have relatively good local Air Quality. Equally, on a day with significantly less congestion the locality can have relatively poor local Air Quality.

Once released into the atmosphere Nitrogen Oxides (NOx) gradually disperse and are eventually broken down by sunlight.

With this in mind, when trying to improve air quality;

- *Is Air Quality the most appropriate measure when controlling traffic?*
- *Can a more reliable method be demonstrated?*

Air Quality can be described as;

Pollution Source + Atmospheric Conditions + Topological Arrangement = Air Quality

The Solution

Dynniq's VEM package has been a progressive move away from traditional Air Quality measuring techniques. At the request of the Transport Systems Catapult we developed a method of controlling motorway traffic using Air Quality as the primary input. The frequent, erratic nature of the measurements caused by rapid changes in atmospheric conditions (vortices caused by vehicles) meant that defining a reliable trigger would be difficult. What's more, associating a change in emissions to a change in the network was all but impossible without a dispersion model to determine the relationship.

The model would help the operator to untangle the impact of atmospheric conditions and calculate the associated change in pollutants emitted. Essentially working from right to left in the equation on previous page. However, this method proved to be prohibitively expensive to fund.

It is Dynniq's belief that Air Quality monitors are too sensitive and too far detached from the source to appropriately manage traffic. There are systems that aggregate measurements to mitigate this problem – unfortunately these systems are then unable to react effectively to the changing traffic conditions.

The solution however, was far more novel and much simpler to comprehend. The project made the following assertions – ***"if we can't do anything to change the environment or the topography then why would we measure its impact? Also, if we can measure the source reliably and affect a change regardless of what the atmosphere is doing, the net affect will be proportionally equal to the change in source."*** In other words reduce emissions, accurately measure the reduction and improve Air Quality.

In addition to the openness of its architecture the solution has several benefits over more traditional methods;

1. **No requirement for additional infrastructure investment reducing costs, improving safety and not contributing to already congested street furniture.**

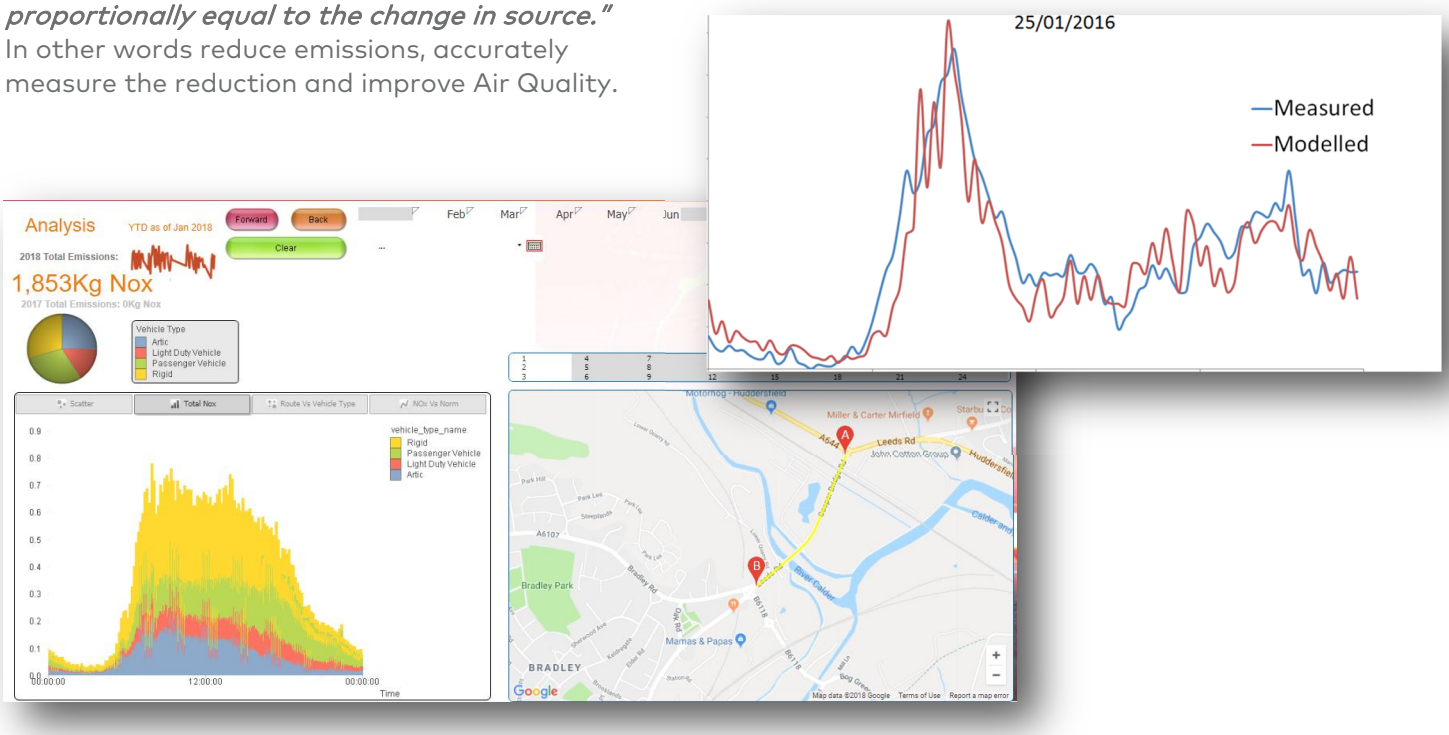
2. **Economy of Scale – after initial configuration and interfaces deploying the monitors across your network is low cost and fast.**

3. **Truly valuable data – Emissions are calculated from a collection of Dynamic and Static data sources. We can provide complete visibility of these so you can clearly see the impact of each data source.**

4. **Economic Analysis – Dynniq's system is able to accurately calculate the financial impact of each site using government approved methods. This makes BCR justification simpler but for much needed improvement works.**

To meet this requirement Dynniq has built the Virtual Emissions Monitor. A method to make use of the big data environment that envelops our industry and applies DfT approved Emissions Factors to calculate in real time emissions across the country.

With the assistance of the DfT and Manchester University we have shown our method to be exceptionally accurate demonstrated below;



The Features and Benefits

The VEM is now being used commercially by our partners; Kirklees County Council has installed the software covering 3km of highway that experiences large volumes of traffic and congestion. The VEM was initially used to calculate the reduction of NOx achieved by implementing adaptive control (SCOOT). Despite more than 200 system installations worldwide, there are few studies published regarding the effectiveness of SCOOT and its impact on Air Quality.

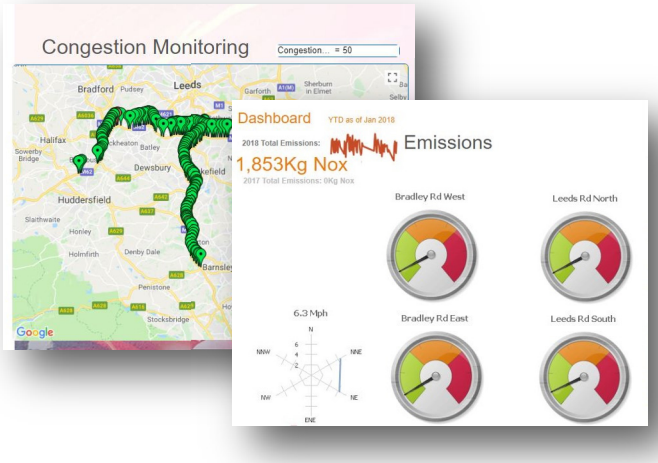
Difficulties associating Air Quality to transport, and therefore determining the effect of SCOOT, have led to inconclusive results and generally unreliable assertions. With the VEM it is now possible to easily perpetuate this link and measure performance minute by minute.

During this study period a 31% decrease in NOx production was observed. The decrease is sizeable given that the reduction in journey time is only expected to reach a maximum of 20%. SCOOT is contributing two quite sizeable benefits to the local Air Quality;

1. **During network saturation the site is able to manage traffic more appropriately. This slight benefit is exaggerated by the fact that at slower speeds or increased stop/start behaviour the amount of NOx produced increases almost exponentially.**

2. **SCOOT has been shown to be most effective when the network is busy but not saturated. During these times stop/start behaviour is greatly decreased due to the system being able to hold vehicles where demand is considered low.**

Following the completion of this project, the VEM will continue to be used to further optimise the SCOOT system and provide additional improvements in the future. A wider implementation of the software would ensure that the benefits of having the system are realised across the network without requiring significant investment.



The VEM has shown itself to be of significant value to local authorities in calculating the impact of their road network. The work so far has provided Dynniq and its users the foundation in which real change can occur. Dynniq is committing to an ambitious development plan to further the technology and expand its reach and features.

Dynniq envisages a future where the VEM can provide suggested signal strategies to operators and even set the signals itself. Work will continue to with our partners to ensure that this vision comes to reality in the near future.

About the Customer

Kirklees is a metropolitan single tier authority, the 13th biggest local authority in the UK in terms of population. Kirklees has an elected Leader and Cabinet structure, and a very talented and dedicated workforce across five directorates:

- Children and Young People
- Place
- Resources
- Communities, Transformation and Change
- Commissioning, Public Health and Adult Social Care

www.kirklees.gov.uk

"Kirklees Council are proactively looking to improve the lives and health of its citizens by providing reliable journey times and improving Air Quality. The VEM trial proves that this can be achieved and although it is not the final solution it now gives us a cost effective means of moving forward to find that solution and achieving or aims."

Dave Caborn
UTC Manager
Kirklees Council

Kirklees COUNCIL

Telephone +44 (0)116 282 8500 or Email info@dynniq.co.uk

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Dynniq UK Ltd
Hazelwood House, Lime Tree Way,
Basingstoke, Hampshire
RG24 8WZ
United Kingdom

T +44 (0)116 282 8500
E info@dynniq.co.uk

www.dynniq.co.uk