
# 2019 CIHT Young Professionals Technology & Innovation Challenge

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# Introduction

***How can technology help us solve the climate and air quality problems and how can the transportation sector create a sustainable future?***

Climate change and air quality issues share a common cause from transportation and are therefore closely linked. The two issues have gained increasing coverage in the past 12 months, as a result of renewed activism, but are viewed at different spatial and temporal scales: climate change (global) and air quality (local).

This presentation focuses upon understanding air quality issues at a local level, and within the United Kingdom context. However, the ways in which technology could sustainably help resolve transport's contribution to both issues as a 'win-win' is the key theme.


The Independent (2019)

Economist (2019)

The Guardian (2019)

# What are Air Quality Issues?

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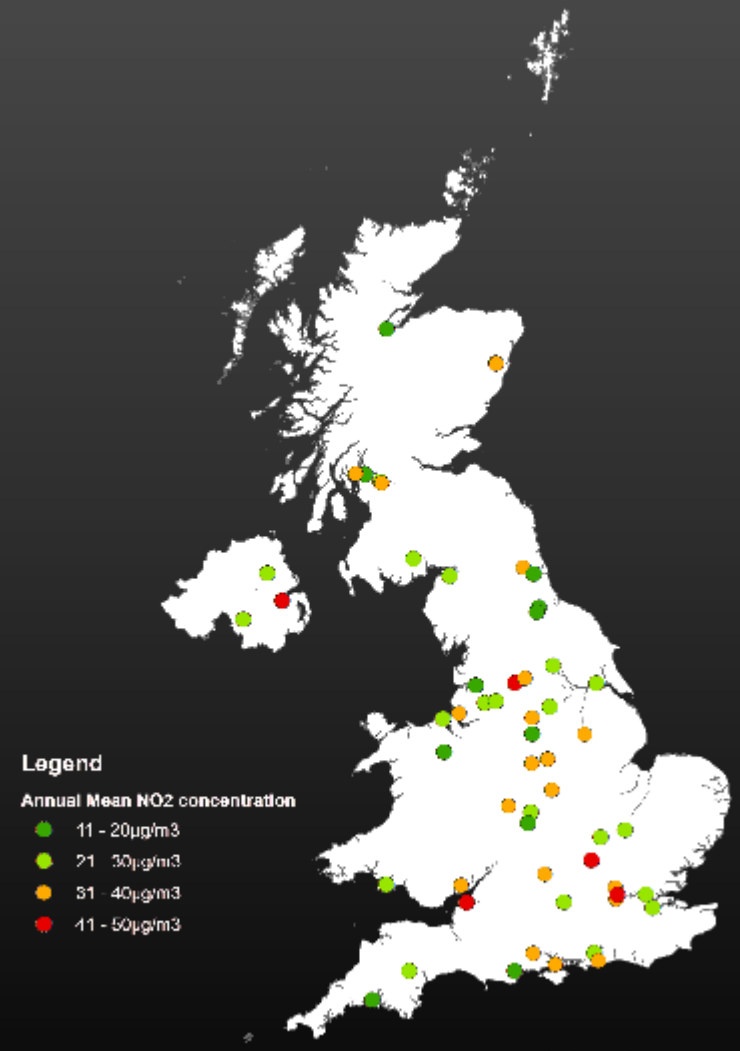
## Globally

According to the World Health Organisation, 91% of the world's population lives in places where air quality exceeds WHO guidelines and there are 4.2 million worldwide deaths per year due to ambient air pollution

## United Kingdom

40,000 deaths per year are attributed to outdoor air pollution, and health problems related to air pollution have cost of approximately £20 billion per year. Road transport is responsible for 80% of nitrogen oxide ($NO_x$) emissions, with 37 of the UK's 43 air quality zones not in compliance with European Union regulations. Emission levels vary drastically across the UK, as shown on the map to the right.




(Ricardo, 2017, Figure 3.2)

**Urban Major Roads, Annual Mean Roadside $NO_2$ Concentration, 2015**

# What's Causing the Issues?

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### Particulate Matter

- *Road transport accounts for approximately 12% of primary particulate matter emissions*
- *Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases*

### Carbon Monoxide

- *Caused by incomplete combustion in vehicle engines.*
- *This gas prevents the uptake of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease*

### Nitrogen Dioxide

- *Road transport accounts for approximately 34% of Nitrogen Dioxide emissions in the UK, and 80% near roadsides. Other transport, such as rail and shipping accounts for approximately 17%.*
- *These gases irritate the airways of the lungs, increasing the symptoms of those suffering from lung diseases*

### Ammonia

- *Agriculture is the main source of Ammonia pollution.*
- *Ammonia reacts in the atmosphere to produce particulate matter, which can result in cardiovascular and respiratory disease.*

### Volatile Organic Compounds (VOCs)

- *Transport accounts for approximately 5% of VOC emissions.*
- *The main sources are construction equipment, and industrial processes. VOCs react with other pollutants to produce ozone, which can cause inflammation of the respiratory tract, eyes, nose and throat.*

### Sulphur Dioxide

- Emissions of Sulphur Dioxide are primarily from combustion of solid and liquid fuels.
- *Sulphur dioxide is a respiratory irritant, which contributes to the formation of acid rain. People with asthma are particularly sensitive. The health effects can occur rapidly.*

*"Air pollution is the top environmental risk to human health in the UK, and the fourth greatest threat to public health after cancer, heart disease and obesity."*
*– Clean Air Strategy, Department for Environment Food & Rural Affairs*

# Who is Affected?

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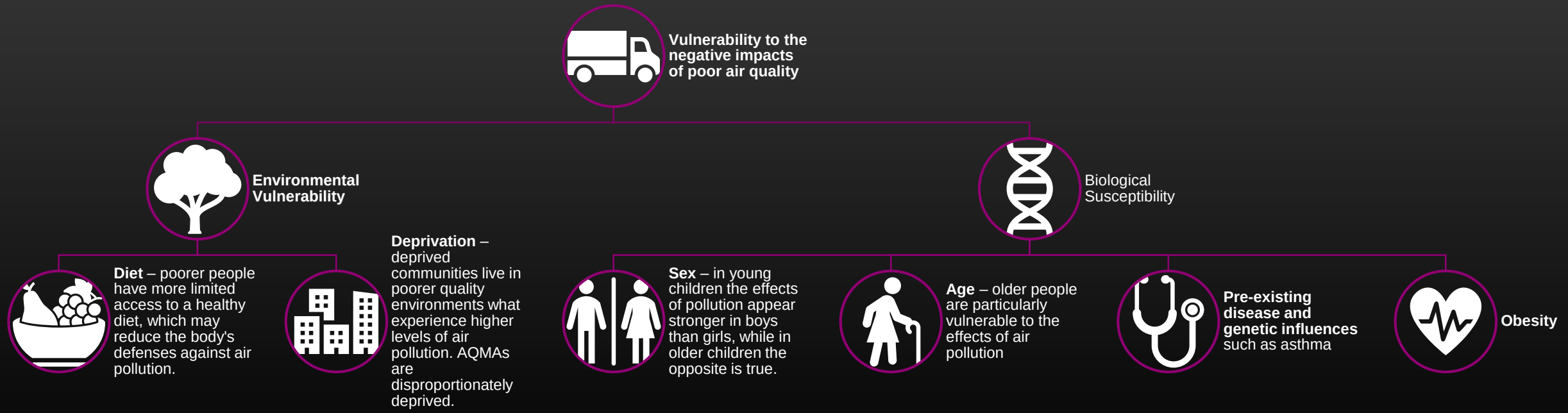
*"People living in low- and middle-income countries disproportionately experience the burden of outdoor air pollution with 91% (of the 4.2 million premature deaths) occurring in low- and middle-income countries. Our most deprived communities are exposed to some of the worst outdoor and indoor air quality, contributing to the gap in life expectancy of nearly 10 years between the most and the least affluent communities.*

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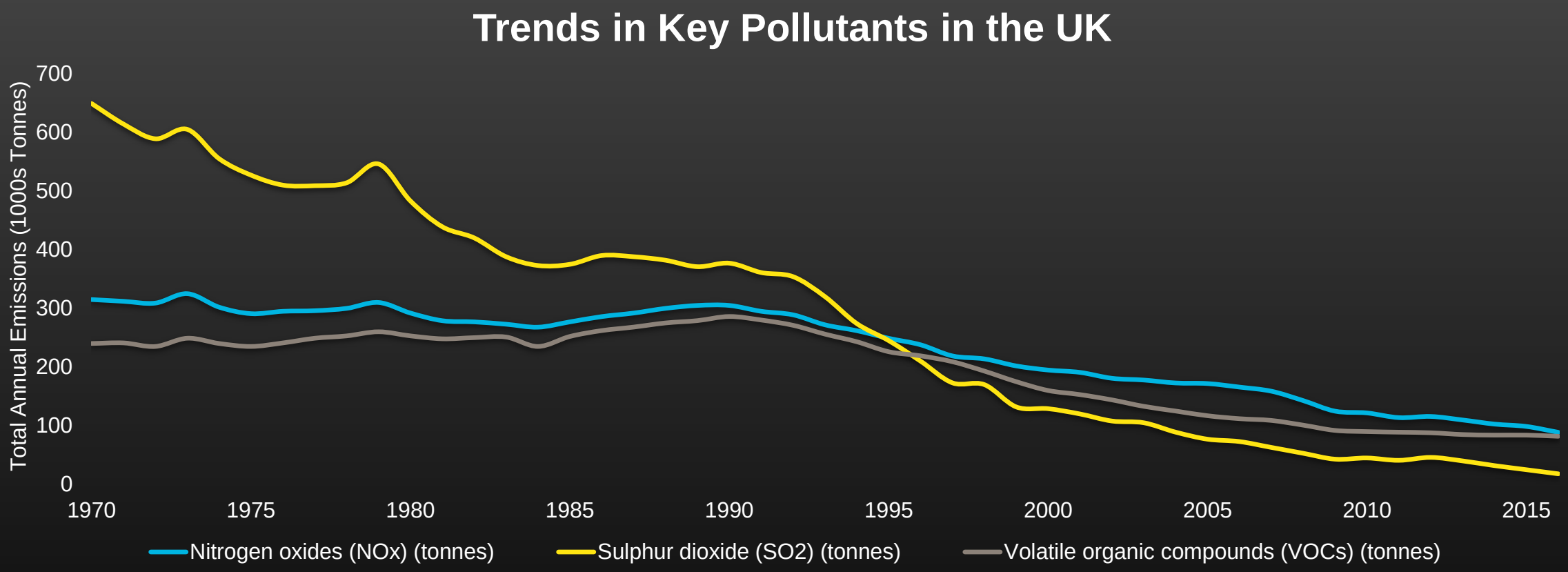
# Trends in Key Pollutants




***Emission levels are reducing but progress is slowing. How can we continue to improve air quality?***

# What is Sustainability?

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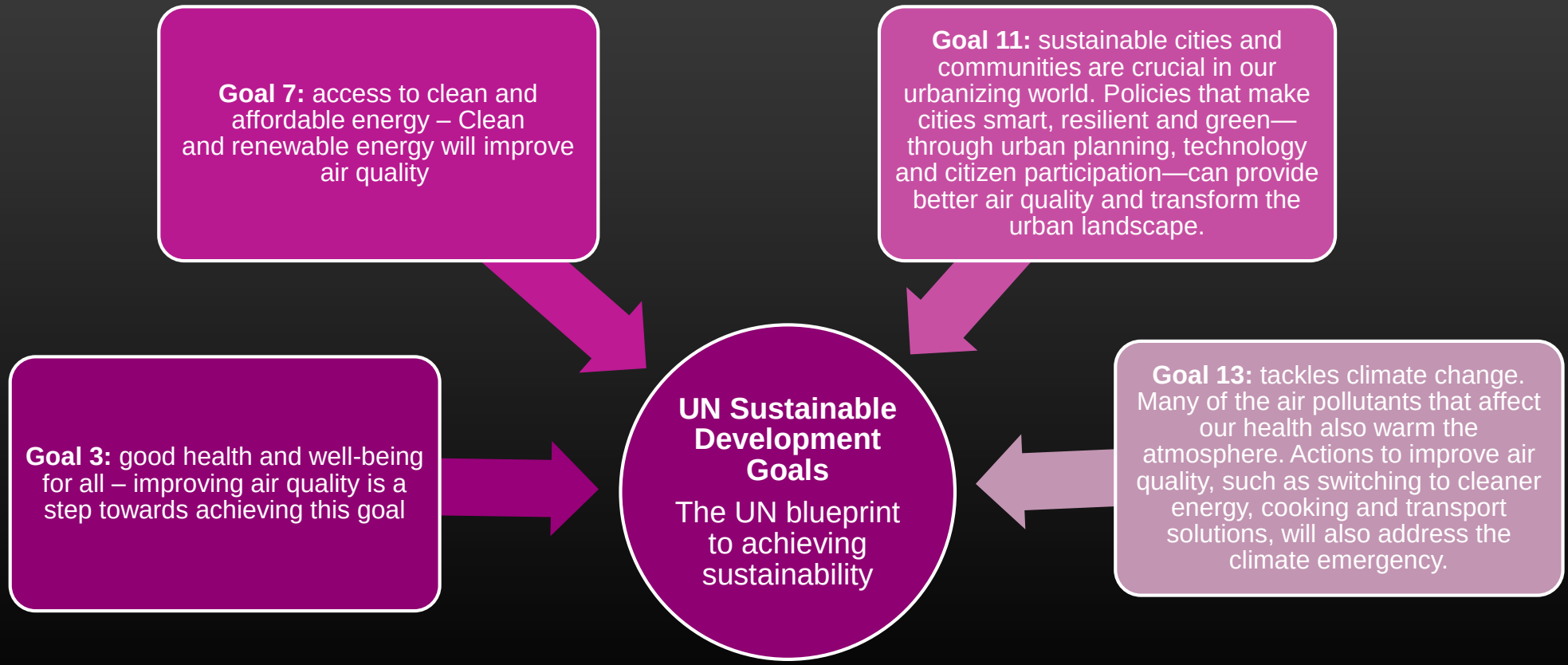
*'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' – Brundtland Report 1987*

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# Sustainable Transport Systems

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*Even when assuming that technological advances alone can resolve environmental issues, the conflicts around achieving sustainability negate the ability of technology to resolve the issues within the timescales needed.*

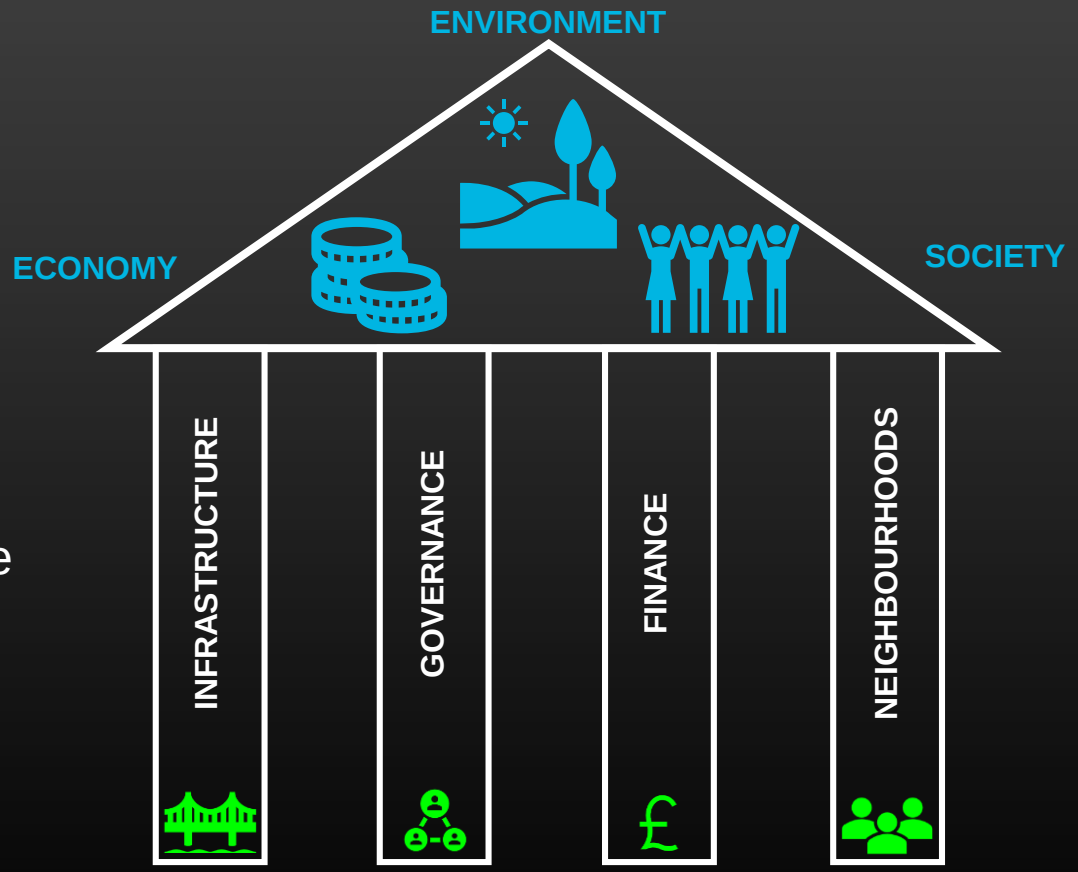
Kennedy *et al.* (2005) argues that four key pillars were necessary to move towards more sustainable transportation

**Governance:** Establishment of effective bodies for integrated land-use transportation planning

**Finance:** Creation of fair, efficient and stable funding mechanisms

**Infrastructure:** Strategic investments in major infrastructure

**Neighbourhoods:** Support of investments through local design



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# How can technology help solve the air quality crisis?

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# Are CAVs the Solution?

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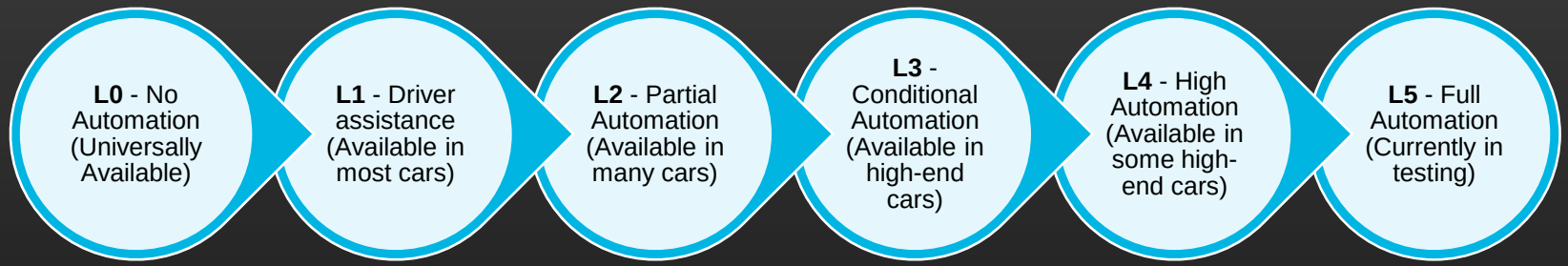
*What are CAVs? Connected and Autonomous Vehicles!*

The UK government has placed emphasis on technological advances as part of it's Industrial Strategy. CAVs have received £100m in investments over the past 5 years, with the government creating the Centre for Connected and Autonomous Vehicles (CCAV). There are various levels of automation, however the main benefits of this technology will occur when all cars are fully automated level 5 (L5).




## Barriers

Safety Standards and Regulations from the 1960s indirectly stop many of the features involved with CAVs. Data privacy and data ownership have led to questions arising such as:

- Who has the rights to use and profit from the large amount of data produced from the CAVs?
- Liability has led to people questioning who is at fault in an accident?
- Significant public infrastructure investment would be required.
- The public must accept this change and be willing to change themselves.

*These barriers can be overcome by alternative solutions…*

# Shared mobility

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Alternative Solutions

***Shared use mobility is broadly defined as the transport services and resources which are shared among users. (Shared-use Mobility Centre, 2019). This can includes all the options identified in the figure to the right (SEA, 2019).***

**Ridesharing & carpooling:** sharing of rides between drivers and passengers with similar origin/destinations

**Ridesourcing:** prearranged and on-demand transportation services for competition which drivers and passengers can connect via digital applications.

**Carsharing:** access to vehicles by joining a maintained fleet of cars and/or light trucks. Use of websites and apps to do so.

**Bikesharing:** on demand access to bicycles at a variety of drops-off and pick-up points.

**Scooter sharing:** access to scooters that are maintained by an organisation at various locations.

**Microtransit:** Technology enabled transit services typically using shuttles or vans providing on demand or fixed services.

Shared mobility will reduce the amount of single car occupancy vehicles which reduces carbon emissions, and encourage community cohesion.

The amount of physical activity will increase which improves the health of thousands and reduces stress on the NHS.

To allow for options to go forward, the government must support the technology such as making scooters legal in the UK.

Stable funding would be required to support the maintenance and growth of these alternative transports which use up to date, expensive technology. However, this would be less expensive than investment in new infrastructure.

The infrastructure must suit the new updates in this technology such as bike racks at suitable areas instead of car parking.

Through consultation and support from the neighbourhood, the community will understand the need for the share use mobility and be more inclined to use this instead of cars.

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Alternative Solutions

# Active Travel

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**What is active travel?** Walking, cycling or using some other form of physical activity for all or part of a journey instead of using motorised transport.

## How can we improve active travel levels?

**Possible improvements to online mapping websites**

- Maps should provide options for safest and quickest routes as well as providing a more scenic route away from traffic for walking and cycling - colour code them.
- Include bike pool stand locations on maps and include journey times involving the bike pool

**Improved provision of information**

- An increase in walking/cycling route websites showing various route info such as the quickest route, gradient and traffic levels.
- Numerous routes to the destination could be highlighted and colour coded to show the difficulty of the route

**Incentives to travel more sustainably**

- Give points and rewards for using pool bikes
- Use apps to log walking/cycling/public transport journeys and get rewarded.

**Creation of a database which is easy to access to public for walking and cycling routes.**

- This may not always be the national routes, general PRoW routes should be included too. This database could then also be available as an app as well as an online resource.

**Push ads to promote cycle mobility classes to build people's confidence in cycle on-road.**

- This could encourage people to overcome barriers which prevent them from travelling sustainably.

These technological advances would require no changes to infrastructure but would encourage the optimisation of the use of existing infrastructure.

Although these options would cost money to develop, they would facilitate maximising the use of existing infrastructure and therefore would require minimal financial investment from local authorities for database development.

These options would encourage people to travel more sustainably, which could result in improved general health and encourage community engagement.

This would enable local government to communicate more effectively with members of the public.

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Alternative Solutions

# Community Involvement

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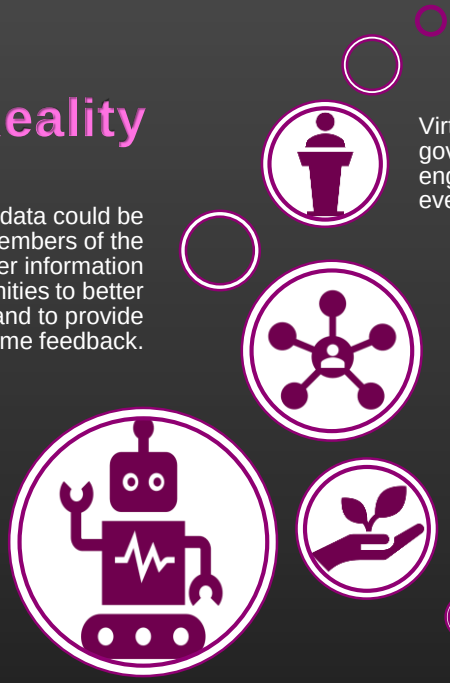
## Virtual Reality

Air quality and traffic data could be interacted with by members of the public to provide better information and opportunities to better understand issues, and to provide real time feedback.



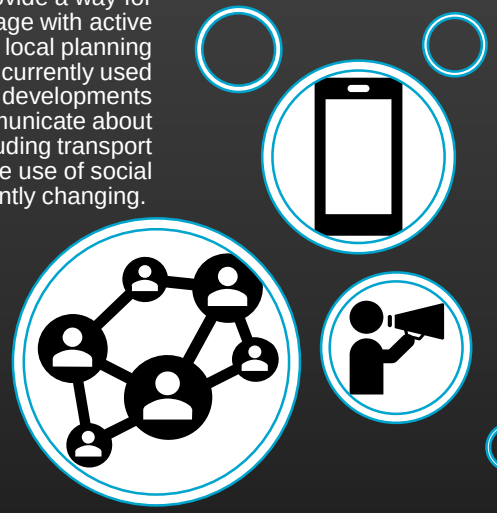
Virtual reality could be used by local government to help public engagement in public consultation events in a number of ways.

It would provide a better way to visualise the impacts on air quality of possible transport system improvements.

It could also be used in simulating environments to help members of the public to engage with the local plan process.

## Community Engagement App

Social media can provide a way for communities to engage with active travel opportunities and local planning processes. Facebook is currently used by communities in many developments and towns to communicate about current local issues, including transport issues. However, the use of social media is constantly changing.



Local authorities could work with active travel charities and communities introduce an to serve this purpose, where members of the public can raise issues with the transport network, with cycle to work and car sharing buddies, walking groups, competitions can be held and promotions can be included which encourage people to travel more sustainably.

By making active travel easy and consolidating all of this information in one app, communities will be encouraged to travel more sustainably, which would improve air quality.

- These technological advances would require no changes to infrastructure but would encourage the optimisation of the use of existing infrastructure.
- Although these options would cost money to develop, they would facilitate maximising the use of existing infrastructure and therefore would require minimal financial investment from local authorities.
- Creating a community engagement app could encourage people to make connections within their own communities, and reduce social exclusion.
- They would encourage the public to engage with local government, promoting the ideals set out in the localism act.

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Alternative Solutions

# National Road-User Charging

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*The ability to charge car drivers for all journeys, based upon time of day, route used and distance. National charging has been described as "10 years away for decades" (Shaw and Docherty, 2014), but are technological advances the final stimulus?*

Road-user charging could potentially be enforced through increased uptake of telematics. Currently favoured by insurance industry, this data could also be applied to 'Smart' national-level charging, as opposed to the expensive Automatic Number Plate Recognition arrangements currently used as part of localised Clean Air Zone implementation and city 'congestion charging' systems. This means that this change would not be expensive to implement.

Road-user charging provides the opportunity to charge the largest polluters the greatest amount, in line with the polluter pays principle. This could have a positive impact on equality in communities.

Fuel duties are currently a significant source of revenue for UK Government: £28.4 billion expected in 2019-20 (Office for Budget Responsibility, 2019), but this could reduce significantly with increased ULEV uptake. Road-user charging could replace this revenue to ensure proper maintenance of the transport system.

This idea could be difficult to implement politically - the 'Motorway Man' and 'Motorway Woman' are very influential (BBC, 2010).

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# Our Vision for the Future

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*"Great things are done by a series of small things brought together."*
*- Vincent Van Gogh*

**Virtual Reality**

*The public are more engaged with changes to infrastructure, public money is better invested*

**Sustainable Transport App**

*More people use sustainable modes to travel to work*

**CAVs**

*More efficient use of existing transport network and less emissions at source*

**Shared Mobility**

*Reducing Single Occupancy Car Journeys and Irving efficiency of the transport network*

**Active Travel**

*Cleaner journeys and reduced number of vehicles on the network.*

**Road User Charging**

*Demand responsive charging to encourage reduction in car use*

## A Sustainable Future

*A carbon-neutral transport future with limited climate and air quality problems*

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