



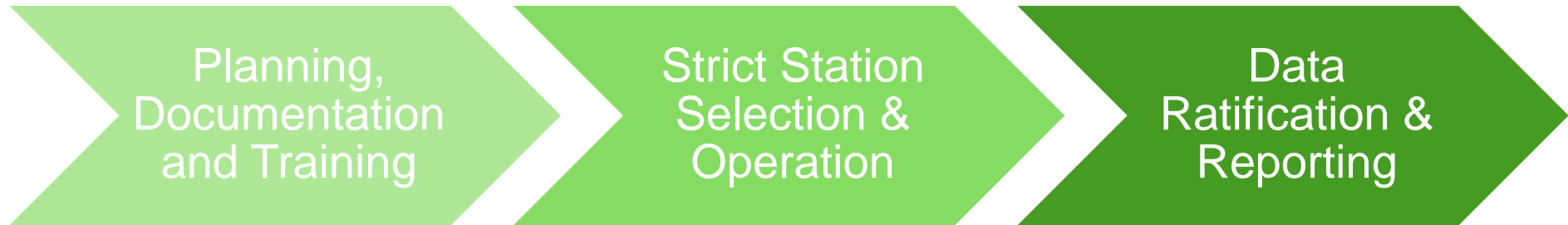
Services to develop an EU Air Quality index and a specific source pollution (smog) index

Dr Stuart Sneddon
Air Quality in Scotland Seminar
26th March 2015

Background... why we are here today

- 2.4 million people die each year from air pollution (WHO)
- 400,000 premature deaths each year in the EU (“A Clean Air Programme for Europe”)
- 500,000 Americans die annually from cardiopulmonary disease linked to ‘smog’ (US HHS)
- £20 billion annual cost in the UK alone (UK Government - Defra)
- In the future air pollution is predicted to kill more people in cities than dirty water and lack of sanitation (OECD)





- EC Directive Compliance Monitoring
 - High quality data for compliance assessment.
 - Objectives defined to prevent, protect and reduce harmful effects on human health.
 - Article 27 of 2008/50/EC and Article 7 of 2004/107/EC require member states to inform the public and appropriate organisations of the ambient air quality in their territory.
 - New e-reporting will make data more accessible.



- Legislative Framework for Setting Emissions Standards
 - Type approval standards for vehicles and non-road mobile machinery – Euro Standards
 - Emissions performance standards for industrial installations. e.g. Directive 2010/75/EU on Industrial Emissions
 - Approved Appliances – UK Clean Air Act.
 - Low Emissions Zones.
 - Eco Labelling (c.f. CO₂ vehicle emissions and appliance energy efficiency labels)

- *“...to develop a prototype of (a) harmonized EU AQ indices for key pollutants and (b) one or more composite smog indices to be calculated from available air pollutant emission data or emission factors. There are three specific objectives:*
 - *The assessment of the current state of play as regards AQ indices in the EU, and pollution performance classification methods for products in the EU and internationally;*
 - *The development of proposed methodologies and IT communication approaches for reporting the EU AQ and smog indices;*
 - *The development of “prototype” EU AQ and smog indices and for a class of examples using available data along with appropriate guidelines that would enable the replicability by national authorities and other interested organisations.”*

Task 1: Development of EU AIR QUALITY INDEX

Task 1.1

- Assessment of current state of play regarding air quality indices, their use and communication.

Task 1.2

- Develop an EU Air Quality Index

Task 1.3

- Develop IT structure/interface

Task 1.4

- Testing and 1st Evaluation

Task 1.5

- Documentation and follow-up

Key features of an AQI

Component	Key Feature
Measurement	<ul style="list-style-type: none">• Selected (criterion) pollutants• Location• Quality• Suitability
Calculation	<ul style="list-style-type: none">• Indicator ranges• Pollutant bands• Break points• Spatial scale• Temporal resolution
Dissemination	<ul style="list-style-type: none">• Frequency, format
Communication	<ul style="list-style-type: none">• Effectiveness of information: engagement, reach.

Scope of Pollutants

- Typically include:
 - Nitrogen dioxide (NO₂);
 - Ground-level ozone (O₃);
 - Particulate matter (PM);
 - PM₁₀
 - PM_{2.5}
 - Carbon monoxide (CO);
 - Sulphur dioxide (SO₂)
- CITEAIR
- USEPA AQI
- China National API
- ABU DHABI AQI
- UK DAQI
- Particulate matter, nitrogen dioxide and ozone have been highlighted as the most important air pollutants from the point of view of human health.
- Many Member States of the EU have failed to achieve compliance with the limit values set out in the Air Quality Directive and the Fourth Daughter Directive by the due dates.
- Different approaches to aggregating pollutants – average, worst case etc.

Examples of Air Quality Indices in Common Use

Country/Region	Name	Hyperlink to Index
USA	USEPA Air Quality Index	http://cfpub.epa.gov/airnow/index.cfm?action=aqibasics.aqi
UK	Daily Air Quality Index	http://uk-air.defra.gov.uk/air-pollution/daqi
Abu Dhabi	Air Quality Index	http://www.adairquality.ae/en/home/theme.aspx?ThemeID=bc1b661a-ba6e-4ef9-866a-639bb1e5bfde
Hong Kong	Air Quality Health Index	http://www.gov.hk/en/residents/environment/air/aqi.htm
Canada	Air Quality Health Index	http://www.ec.gc.ca/cas-aqi/default.asp?Lang=En&n=065BE995-1#calculated
Ontario	Air Quality Index	http://www.airqualityontario.com/reports/summary.php
Europe	CITEAIR	http://www.airqualitynow.eu/
Australia	Air Quality Index	http://www.environment.nsw.gov.au/aqms/aqi.htm

Examples of Index Banding Schemes

Criterion	US EPA AQI	Abu Dhabi AQI	NSW AQI	UK DAQI	Canada AQHI	Ontario AQI
Number of bands	6	6	6	4	4	5
Scale	0-500	0-500	0-200+	1-10	1-10+	0-99+
Band 1 (best AQ)	0-50 Good	0-50 Good	0-33 Very Good	1-3 Low	1-3 Low	<15 Very Good
Band 2	51-100 Moderate	51-100 Moderate	34-66 Good	4-6 Moderate	4-6 Moderate	16-31 Good
Band 3	101-150 Unhealthy for sensitive groups	101-150 Unhealthy for sensitive groups	67-99 Fair	7-9 High	7-10 High	32-49 Moderate
Band 4	151-200 Unhealthy	151-200 Unhealthy	100-149 Poor	10 Very High	10+ Very High	50-99 Poor
Band 5	201-300 Very Unhealthy	201-300 Very Unhealthy	150-200 Very Poor			>99 Very Poor
Band 6 (worst AQ)	301-500 Hazardous	301-500 Hazardous	200+ Hazardous			

- Ricardo-AEA are working closely with the EEA to develop a prototype European AQI system
 - Using our experience of working in the Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM), EIONET reporting, and on the prototype and implementation of INSPIRE compliant e-Reporting data flows.
 - UTD data flows with the EEA have already been established.
 - Historical data flows to follow shortly.
 - All systems are based on INSPIRE principles.
 - It's expected that the EEA will host the system centrally once implemented.

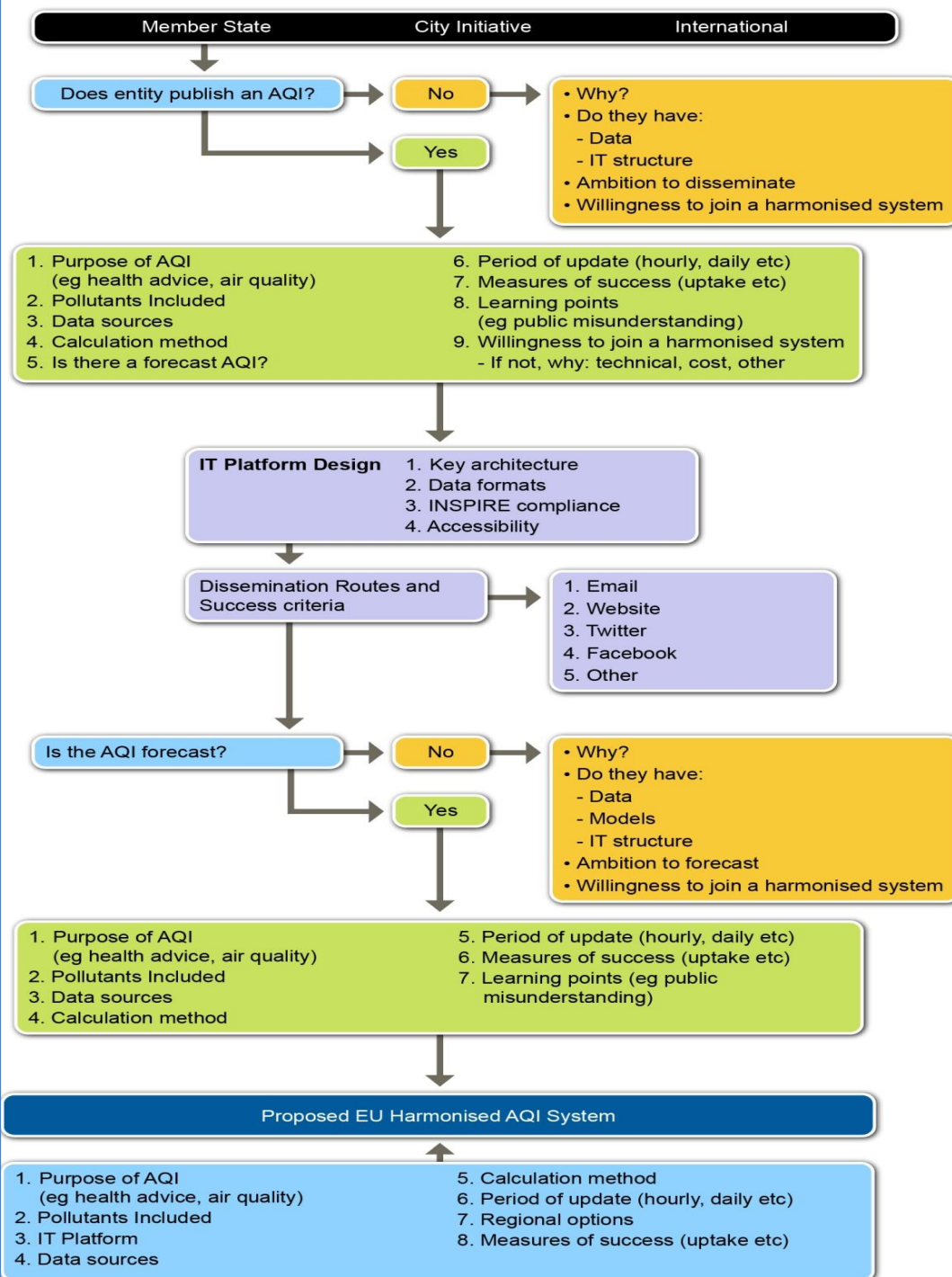
Which time periods to use?

- Conflict between “real-time” reporting and longer term averaging periods – 3-hourly, 8-hourly, daily, weekly, annual.
- Well documented in the UK and other studies – use “running” means to report “latest” data but fixed daily or annual data for historical “Look-back” reporting.
- Incorporate modelled data for today and future days forecasts.
- Use short-term “trigger values” based on a statistical model to identify pollution episodes in real-time as they emerge.
- Conflict between the stringency of short term and annual objectives for NO₂. Short term objectives are infrequently breached but annual means frequently exceeded.
- Long-term vs. short-term health effects.

A systematic Approach to reviewing existing AQIs has been developed

We will review 20 candidate systems plus the CITEAIR Common Air Quality Index (CAQI)

2/3 Europe
1/3 International



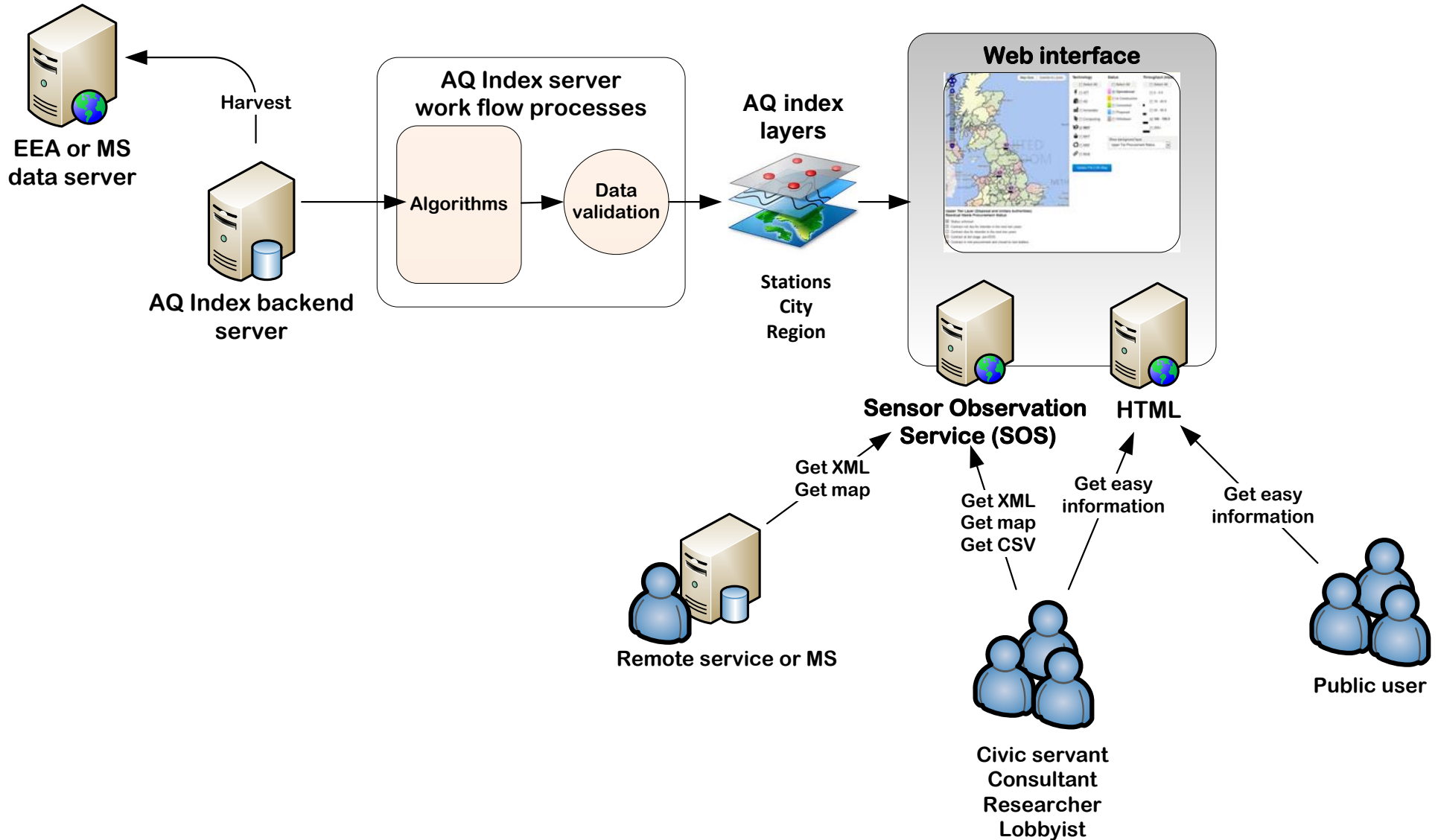
Incorporating Different Location Types?

- Separate indices or reports for traffic and background locations?
- Are industrial locations excluded or treated differently?
- How to deal with incorporating stations which may not measure all pollutants?
- How much metadata needs to be incorporated to help understanding of the AQI for a location – population, traffic flow, meteorology, topography, distance from nearest road etc.
- How to amalgamate stations across cities to create an overall AQI (e.g. Europeair)

Prototype website development

- Storyboard the user needs.
- Evaluate the candidate IT solutions.
- Maximise accessibility
- Identify the list of media to which we will be reporting.
- Consider the development of WMS spatial services – Google Maps, ArcGIS server, MapServer etc.
- Consider licensing needs.
- Conformance to open data standards.
- Conformance / alignment with the INSPIRE and Open Data initiatives.

High Level Architectural Design





Example Outputs

National Air Quality Forecasts / Data

Forecast maps (provided by the Met Office)

Daily Air Quality Index - Wednesday 25/06/2014

Enter your location or postcode to see the forecast for your area:

Index Bands

1	2	3	4	5	6	7	8	9	10
Low			Moderate			High		Very High	

» Health advice associated with air pollution
 RSS Air Quality Forecast
 Daily forecast tweets from @DefraUKAir

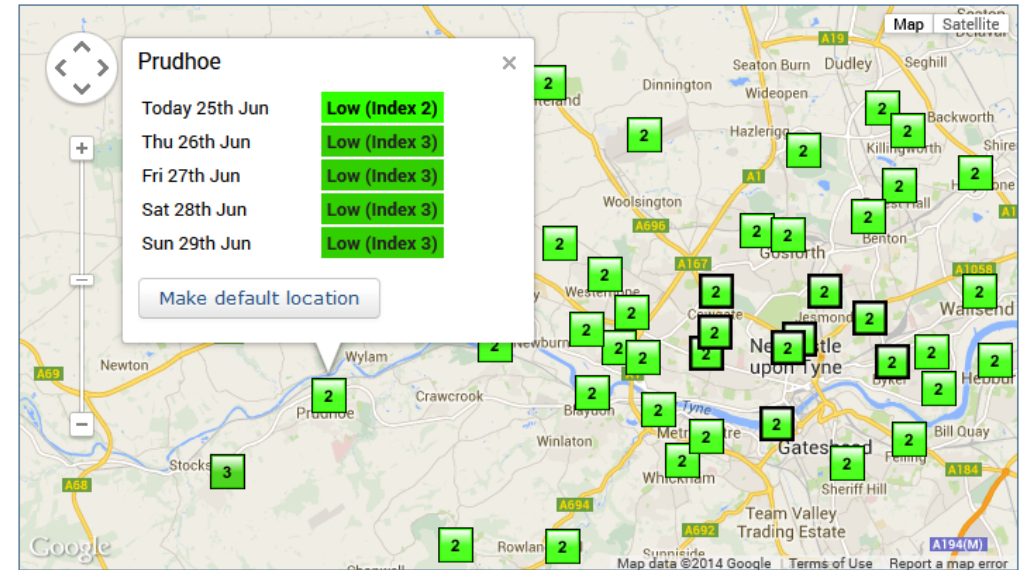
Up to 5 day forecasts are available, use the links below to step through each day.

« Prev Next »

Today (25th June 2014)
Thursday (26th June 2014)
Friday (27th June 2014)
Saturday (28th June 2014)
Sunday (29th June 2014)

Today 25th Jun Thu 26th Jun Fri 27th Jun Sat 28th Jun Sun 29th Jun

Air pollution forecast for Today (25th June 2014) near Newcastle



- Good for the big picture
- Forecasts interpolated based on national models and emissions inventories, include assumptions & uncertainties.
- Measurements are for specific point locations.

The nearest locations to your postcode region are shown below and highlighted on the map.

Location	Today 25th Jun
Newcastle upon tyne Distance away: 0.06 miles Make default location	Low (Index 2)
St james park Distance away: 0.24 miles Make default location	Low (Index 2)
Newcastle upon tyne youth hostel Distance away: 1.08 miles Make default location	Low (Index 2)
Heaton (tyne and wear) Distance away: 1.48 miles Make default location	Low (Index 2)
Fenham Distance away: 1.97 miles Make default location	Low (Index 2)

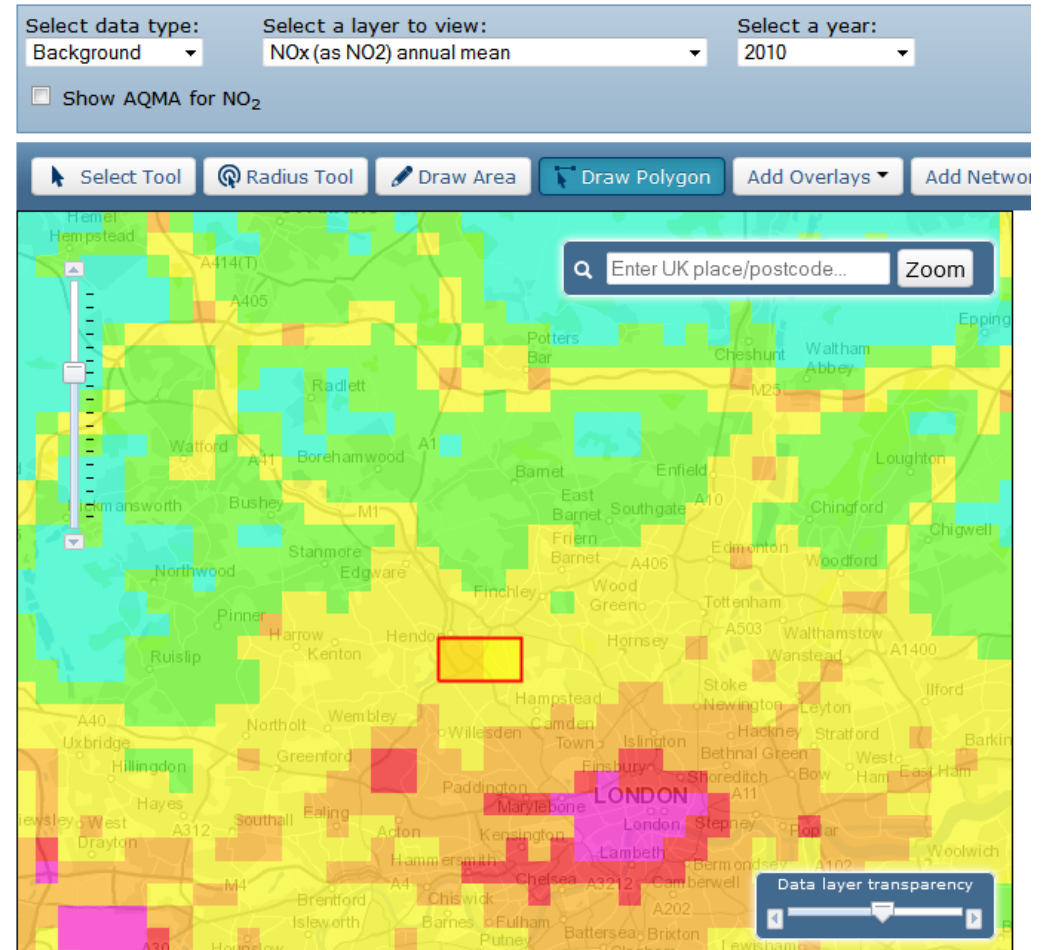
Tweets

Defra Air Quality @DefraUKAir 19m
 Forecast Thu: Low air pollution for most of UK, but Moderate in parts of the south and west. bit.ly/HbGVCK #ukair

Defra Air Quality @DefraUKAir 4h
 Latest Wed 9am: Low air pollution measured across all regions of the UK. bit.ly/HN9VOK #ukair
 Expand

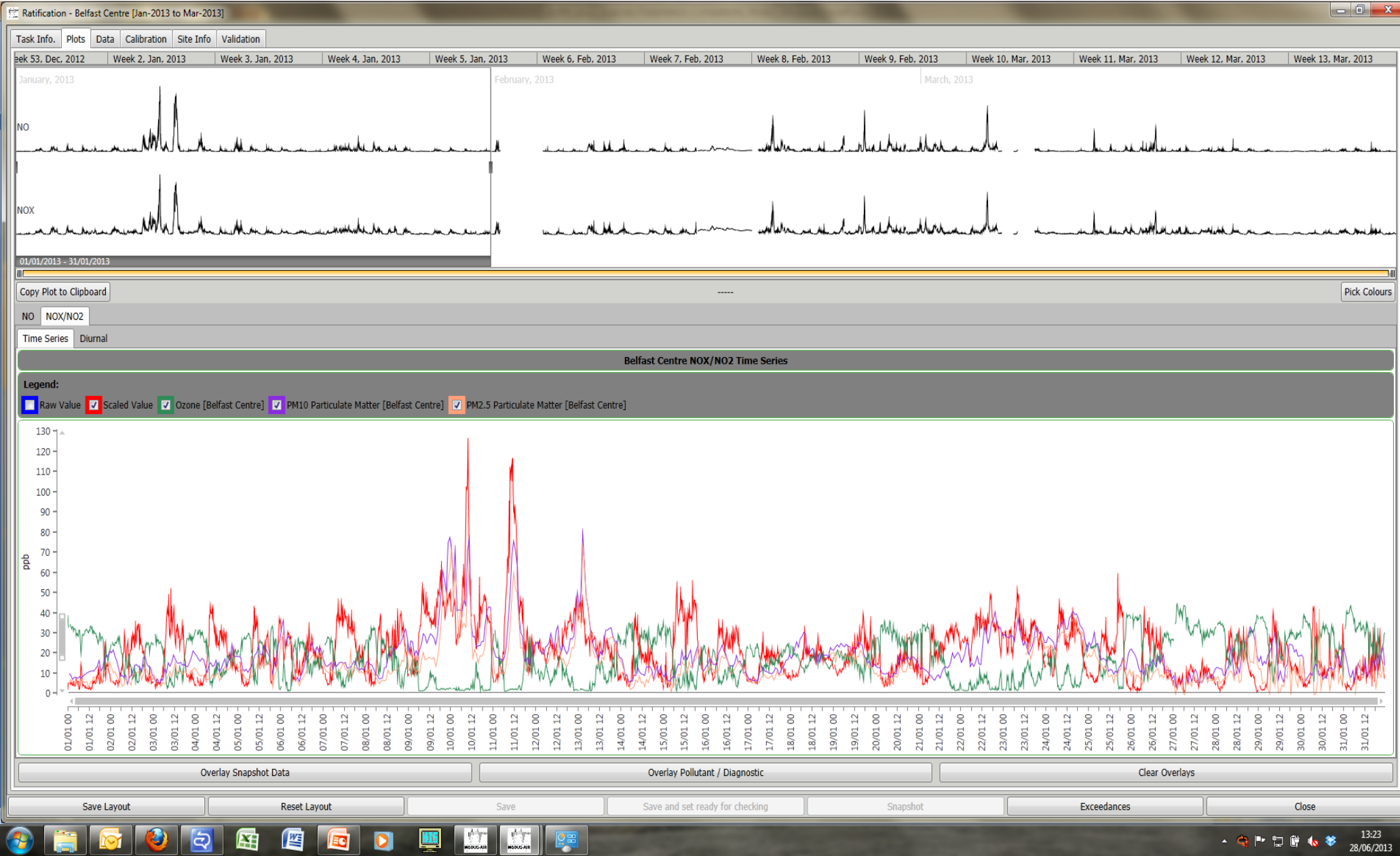
<http://uk-air.defra.gov.uk/forecasting>

Local City Scale Models and Forecasts



- More local detail
- Local accuracy improved

This is not what the public want to see



Example Portal

RICARDO-**AEA**



ELM FOR COMMUNITIES

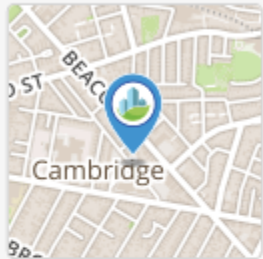
ELM FOR CITIZENS

HOW IT WORKS

VIEW THE MAP

GET ELM

96 LINE STREET, SOMERVILLE 02143, MA



Air Quality Level
GOOD

Right now

41 °F

°F | °C

Air quality during the past :

custom period

Last updated
Dec 4th, 2014 at 5:38 pm

11/29/2014

to 12/4/2014

Nitrogen
Dioxide



Ozone



Organic
Compounds



Particulates



Noise



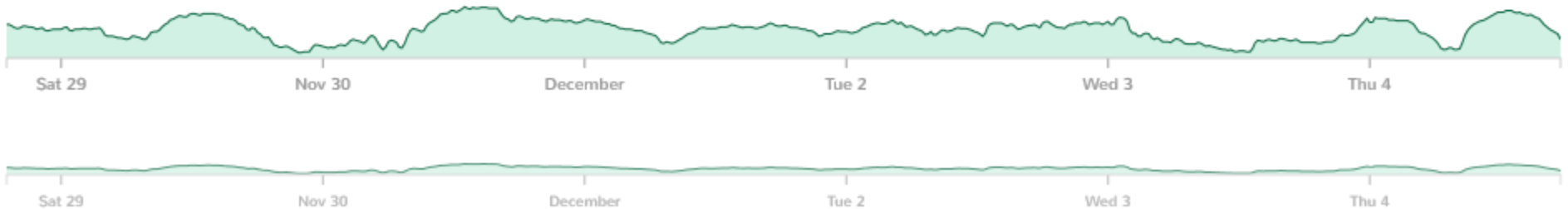
Humidity



Poor (300)

Moderate (150)

Ozone



Focus

Data can be linked to apps & alert services to provide pro-active health warnings



airAlert

airAlert is a service that sends free messages direct to vulnerable people informing them about air pollution levels in their area.

Please choose your county from the links below...

Current airAlert



Current airAlert



Current airAlert



Current airAlert



Task 2: Task 2 – Development of Prototype Specific Source Pollution Index

Task 2.1

- Assessment of current situation regarding pollutant performance classifications

Task 2.2

- Develop methodology for calculating and disseminating SSPI

Task 2.3

- Develop searchable web-based or other interface

Task 2.4

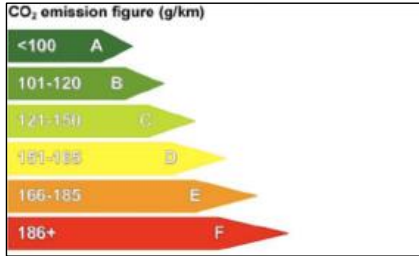
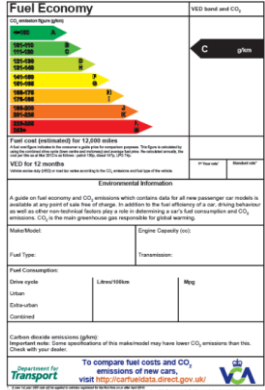
- Testing and Evaluation of "Beta" version


Task 2.5

- Documentation and follow-up

Specific Source Pollution Index

- To inform and support consumers in their procurement of products – specifically road vehicles and small commercials/domestic combustion products.
- Carry out a literature review of existing pollution performance classifications
 - Mandatory vs voluntary
 - Measurand (pollutant) and product
 - Measurement boundaries
 - Presentation and dissemination
 - Feedback from consumers
 - How does rating relate to policies?
- We will produce factsheets for 15 candidate systems, 2/3 Europe & 1/3 International
- Identify opportunities for mutual recognition of classification schemes

Performance Classification	EU CO ₂ labelling scheme
Country/Level of Application	European Union (EU-28) – mandatory
Classification Focus	CO ₂ emission factors [g/km]
Classification Approach	Measured CO ₂ emissions
Performance Classification Boundary	Tailpipe emissions
Performance Classification Scale	Label Example
 <p>General ranges for performance classification</p>	
General description	The EU CO ₂ labelling scheme requires displaying on labels CO ₂ emissions fuel consumptions for a particular make, model range, engine capacity, fuel type transmission type. The model should be recognisable to customers by the vehicles are badged. Cars are rated according to the actual CO ₂ emissions compared to the entire range of potential models, regardless of its size or type. also useful for comparing cars within the same type or class. The performance classification scheme is based on the EU Energy label and is harmonised across member states to avoid confusion and to improve customer recognition.
Types of labelled vehicles	New passenger cars. Depending on the Member State, could be extended to used vehicles.
Considerations on Fuels	No distinction is made between fuels. The main indicator is the CO ₂ emission factor of the vehicle, regardless of the fuel.
Considerations on Size	No distinction is made between sizes or engine capacities. The main indicator is CO ₂ emission factor of the vehicle, regardless of the fuel.
Considerations on Technology	No distinction is made between technologies. The performance classification applicable to all types of vehicles: fossil-fuelled, hybrid, electric, etc.
Relation to air quality abatement policies	Conditioned by specific air quality policies in Member States. Not related in European context.
Public awareness and accessibility	Public awareness is substantial. The performance rating has been advertised in media. The availability of information is wide. Ratings can be obtained from National Member State energy authorities or directly from car manufacturers.
References	Gibson, G., 2013. Car CO ₂ labelling in Europe. Presentation given on behalf of Ricardo-AEA. 30 th April 2013. Available online. Mahlia, T.M.I, Tohno, C., Tezuka, 2012. History and current status of the vehicle energy labelling and its implementation possibilities in Malaysia. Renewable and Sustainable Energy Reviews 16, 1828-1844.

Measure Name	Low Emission Zone (LEZ)				
Measure in Europe			Description of Measure		
			<p>Low emission zones (LEZ) are areas where vehicles that do not meet a minimum standard for vehicle emissions are restricted from entering and are subject to large fines if they do enter. LEZs are deemed restrictive measures since they affect driving habits and involve fleet renewal. They are also known as Environment Zones, Umweltzonen, Milieuzones, Lavutslipssone, Miljözone, or Miljøzon. Most LEZs operate 24 hours a day, 365 days a year, with some of the Italian LEZs currently the only exceptions to this rule.</p> <p>More than 200 LEZ have already been implemented in Europe, with the LEZ of London (UK) and Stockholm (Sweden) the most known examples. Examples of other LEZs across Europe are found in Antwerp, Athens, Prague, Copenhagen, Berlin, Bremen, Karlsruhe, Budapest, Amsterdam, Utrecht, Rome, Palermo, Verona, Lisbon, Trondheim, Brighton and Oxford.</p> <p>No examples of LEZ were found outside Europe at this stage.</p>		
			Number of Cities in Europe	404	
		Number of Cities Worldwide	404		
Representative examples in Europe					
Implementing City	No. of Roads/Area	Affected vehicle types	Performance Classification	Charges/Fines	Implementation Degree
Athens	28 roads (small ring), 21 roads (large ring)	All vehicles weight >2.2 t and age pre 1990	Weight/age. Exemptions for CO ₂ consumption <140 g/km	€200	Permanent (2014)
Lisbon	9 roads (2 zones)	All vehicles with Euro2 (LEZ) and Euro1 (extended area)	Euro Standard (PM)	None	Permanent (2012)
London	1580 km ²	Lorries >3.5t, GVW, buses and coaches >5t (Euro4, Euro3)	Euro Standard (PM) and weight	£100-£500	Permanent (2008)
Milan	8.2 km ²	All vehicles (petrol <Euro1, diesel <Euro3)	Euro Standard	€75-€450	Permanent (2011)
Stockholm	35 km ²	All HGVs/buses. No Euro2. Euro3 until 2015.	Euro Standard. Registration rate.	1000 SEK	Permanent (1996)
Representative examples outside Europe					
None	None	None	None	None	None

- How are performance classifications applied in restricted areas?
 - LEZ and ULEZ
 - Road pricing strategies
 - Speed calming zone
 - Car free zones
 - Urban access and parking restrictions

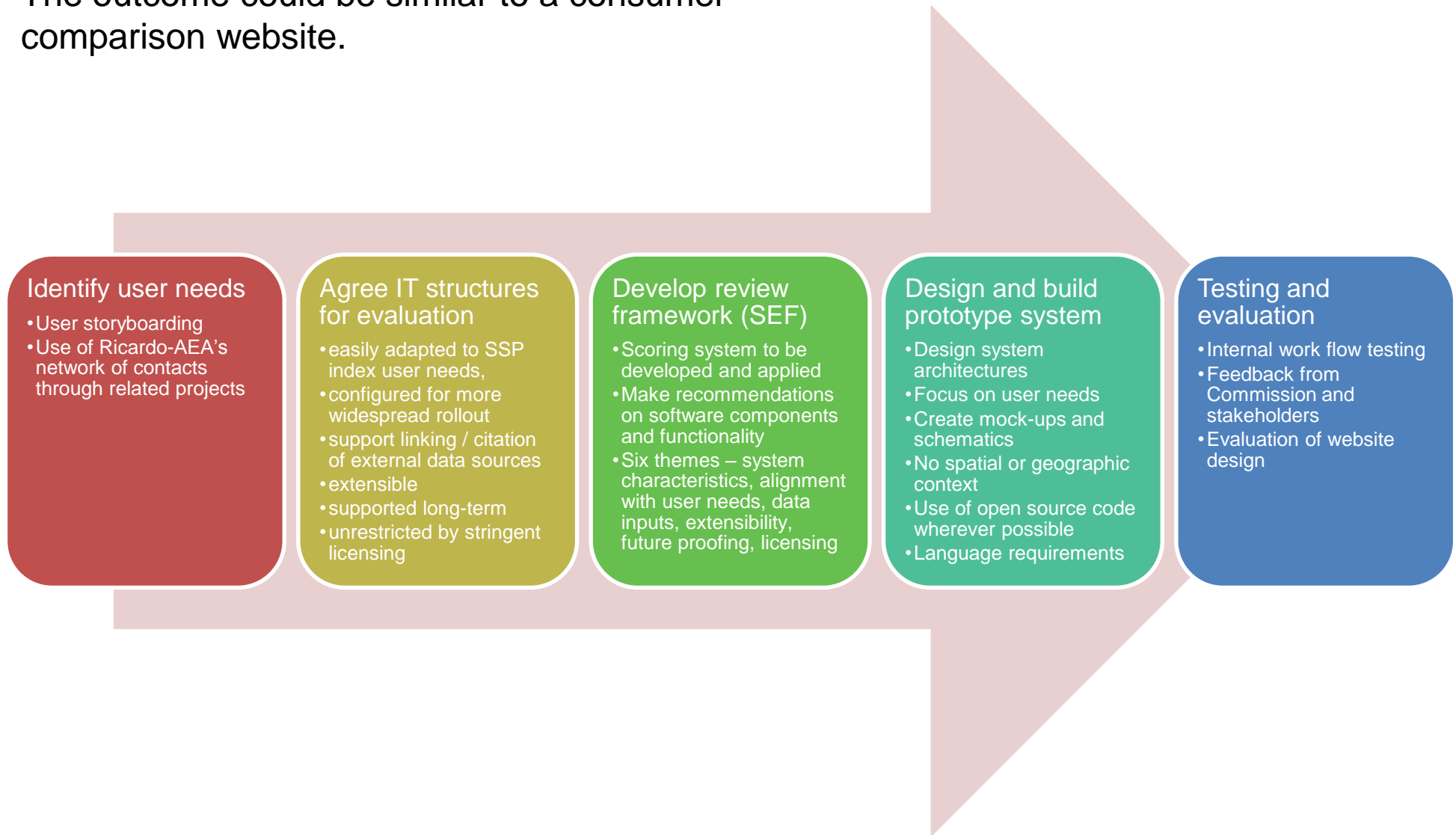
- We will review 15 candidate restriction schemes.
- Effect of results on development of AQI
 - Alignment of pollutants
 - Consideration of threshold AQI which might trigger application of restriction
 - Inclusion of metadata explaining traffic restrictions which may apply to cars in each index band

- Don't repeat the mistakes of the Euro standards – use of real world test data
 - Extensive stakeholder consultation will be needed if this is to be fully implemented
- Basis of the passenger vehicle SSPI:
 1. Use of Euro Standards for PM and NO_x to set boundaries between index bands
 2. Individual make/model to be assigned an index based on real world emission data for both PM and NO_x
 3. Consider how to aggregate the two pollutants into one overall index
 - Aim for a single index to cover all fuel types.
 - Is it feasible to introduce other pollutants?
 - No Euro Standard exists for PM from petrol cars – how do we set index boundaries?
- Task led by Yvonne Pang – UK expert in Road Transport Emissions

- We will only consider operational emissions not the full lifecycle of the product.
- We will review a wide range of literature including the Ecodesign Directive, Ecostars, Nordic Swan.
- We will refer to the EMEP guidebook to determine the emission factors to be used to develop the index.
- Index boundaries could also be based on health impacts/damage costs.
- Could use approach whereby the top performing 10-20% of products are fixed into the top/best index value. This would be a relative approach rather than absolute.
- The scope of combustion products to which the index system will apply will not include room heaters but cover domestic boilers and housing association systems.
- Several pollutants to consider (at least PM and NO_x)– will consider how to generate an index banding system for each and then aggregate them into a single system.
- Index should be technology neutral – not setting boundaries using different standards for different fuel types.

- Task led by Robert Stewart – UK expert in emissions from stationary combustion sources.

The outcome could be similar to a consumer comparison website.



- **Task 1.1 – Assessment of current state of play**
 - A review paper presenting the current state of play regarding Air Quality Indices.
- **Task 1.2 – Development of EU AQ Indices**
 - The outputs from Tasks 1.1 and 1.2 will be combined in a “review and recommendations” report. We recommend a workshop to present findings to the key stakeholders and the European Commission (coincide with the planned interim project meeting)
- **Task 1.3 – Development of an IT infrastructure/interface**
 - A SEF report which will include the framework used, user stories, evaluation criteria and scores for each IT system, recommendations, system design specification, data processing work flow, mock ups, system architecture, information on data feeds
- **Task 1.4 – Test phase and first evaluation**
 - Beta website, demonstration and briefing report, including testing conducted, observations and their implications, recommendations for improvement
- **Task 1.5 – Documentation and follow-up**
 - A final written report setting out the background, aims and objectives, a description of the methodology used and key issues addressed, results, conclusions, recommendations and actions, estimates of time and costs required to maintain the AQ Index and software delivered.

- **Task 2.1 – Assessment of Current State of Play**
 - A collection of factsheets with information on the reviewed labelling schemes.
 - A collection of factsheets with information on the reviewed traffic restrictions and measures.
- **Task 2.2 – Development of SSPI**
 - The outputs from Tasks 2.1 and 2.2 will be combined in a “review and recommendations” report. We recommend a workshop to present findings to the key stakeholders and the European Commission (coincide with the planned interim project meeting)
- **Task 2.3 – Development of an IT structure / webpage / communication interface**
 - A SEF report which will include the framework used, user stories, evaluation criteria and scores for each IT system, recommendations, system design specification, data processing work flow, mock ups, system architecture, information on data feeds
- **Task 2.4 – Test phase and first evaluation**
 - Beta website, demonstration and briefing report, including testing conducted, observations and their implications, recommendations for improvement
- **Task 2.5 – Documentation and follow-up**
 - A final written report setting out the background, aims and objectives, a description of the methodology used and key issues addressed, results, conclusions, recommendations and actions, estimates of time and costs required to maintain the SSP Index and software delivered.

Thank you

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