CITI-SENSE Project

Development of sensor-based Citizens' Observatory Community for improving quality of life in cities

Low–cost sensors – some experiences to date

SECURE Workshop Use of low-cost sensor technology to monitor air quality & engage citizens, 30th March 2016

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Grant agreement nº: 308524

CITI-SENSE, http://www.citi-sense.eu/

- **Development of sensor-based Citizens' Observatory Community for improving quality of life in cities**

- Funded by the EU DG Research
- Large, multi-centre, collaborative research project
- Led by NILU – Norwegian Air Pollution Research Centre
- 27 Partners, mostly Europe, IOM one of these
- Started 1 October 2012, for 4 years

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CITI-SENSE, http://www.citi-sense.eu/

- EU funded project that develops “citizens’ observatories” to empower citizens to contribute to and participate in environmental governance, to enable them to support and influence community and societal priorities and associated decision making.

- https://www.youtube.com/watch?v=X6pYcwALVRU

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Creation of a Citizens Observatory…

- Communities of users that will share
  - technological solutions [sensors, software ...],
  - information products and services [outputs of the measurement programmes], and
  - community participatory methods
  - using appropriate communication solutions
- thus complementing established environmental data and information systems and
- with local policy makers / decision makers, improving local environmental decision making

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CITI-SENSE web portal	Gateway to Citizens' Observatories Toolbox. Provides interested parties access to the products & services	**http://co.citi-sense.eu/**
Personal Air Monitoring Toolkit (Atknea LEOs)	Allows users to measure & visualize personal air quality in their immediate surroundings: 1. Mobile sensor unit (Little Environmental Observatory) 2. Android app - connects sensor unit to server (ExpoApp)	 Info.barcelona@ateknea.com **www.ateknea.com/es**
City Air Perception mobile app	Collects and display individual perceptions of air quality, anytime, anywhere. Users can indicate the assumed source of the air pollution	Available from: i-tunes Google Play CityAir
Air Quality Perception Questionnaire	Allows users to describe how they perceive air quality issues. Obtain input on what AQ info. user would like to receive?	http://edinburgh.citi-sense.eu
Data Visualisation Web Pages	Allows viewing of collected data. Based on input from CITI-SENSE platform that collects anonymized information. Within this, data from AQMesh pods will be available	http://srv.dunavnet.eu/new/citisense/OutdoorDataPortal/ http://www.aqmesh.com/product/

Focus today on there products

AQ Mesh pods	Static sensors. Data from these will be displayed through data visualisation webpages	 http://www.aqmesh.com/product/
Personal Air Monitoring Toolkit (uses Ateknea LEOs)	Allow users to measure & visualize personal air quality in their immediate surroundings: 1. Mobile sensor unit (Little Environmental Observatory) 2. Android app - connects sensor unit to server (ExpoApp)	 Info.barcelona@ateknea.com www.ateknea.com/es
Air Quality Perception Questionnaire	Allows users to describe how they perceive air quality issues. Also what info. on AQ user would like to receive?	http://edinburgh.citi-sense.eu

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AQMesh pods

- Wireless battery powered system
- Data transmitted for processing, correction algorithms applied, readings produced

Parameter	Range	#1Limit of detection	#2Accuracy (in standard test conditions)
NO	0 to 4,000 ppb	< 5 ppb	±5ppb
NO2	0 to 4,000 ppb	<10 ppb	±5ppb
O3	0 to 1,800 ppb	< 5 ppb	±5ppb
CO	0 to 6,000 ppb	< 5 ppb	±5ppb
Pod temperature	-20 to 100 °C	0.1 °C	± 2 °C
Pressure	500 to 1500 mb	1 mb	±5 mb
Humidity	0 to 100 %RH	1 %RH	±5 % RH
Particle count	1 – 30 µm		
PM 2.5	0 – 500 µg/ m3		
PM 10	0 – 1,000 µg/ m3		

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AQ Mesh pods

- Received 24 AQMesh pods
  - Gas protocol v3.5, particle protocol v1.0
- Placed for ~1.5 months at reference monitoring sites.
  - Five reference sites used
  - Number of pods co-located at a site ranged from 2-6
  - Allow offset and slope to be applied (where possible)
- Deployed in various locations of Edinburgh
  - Intention for data fusion mapping

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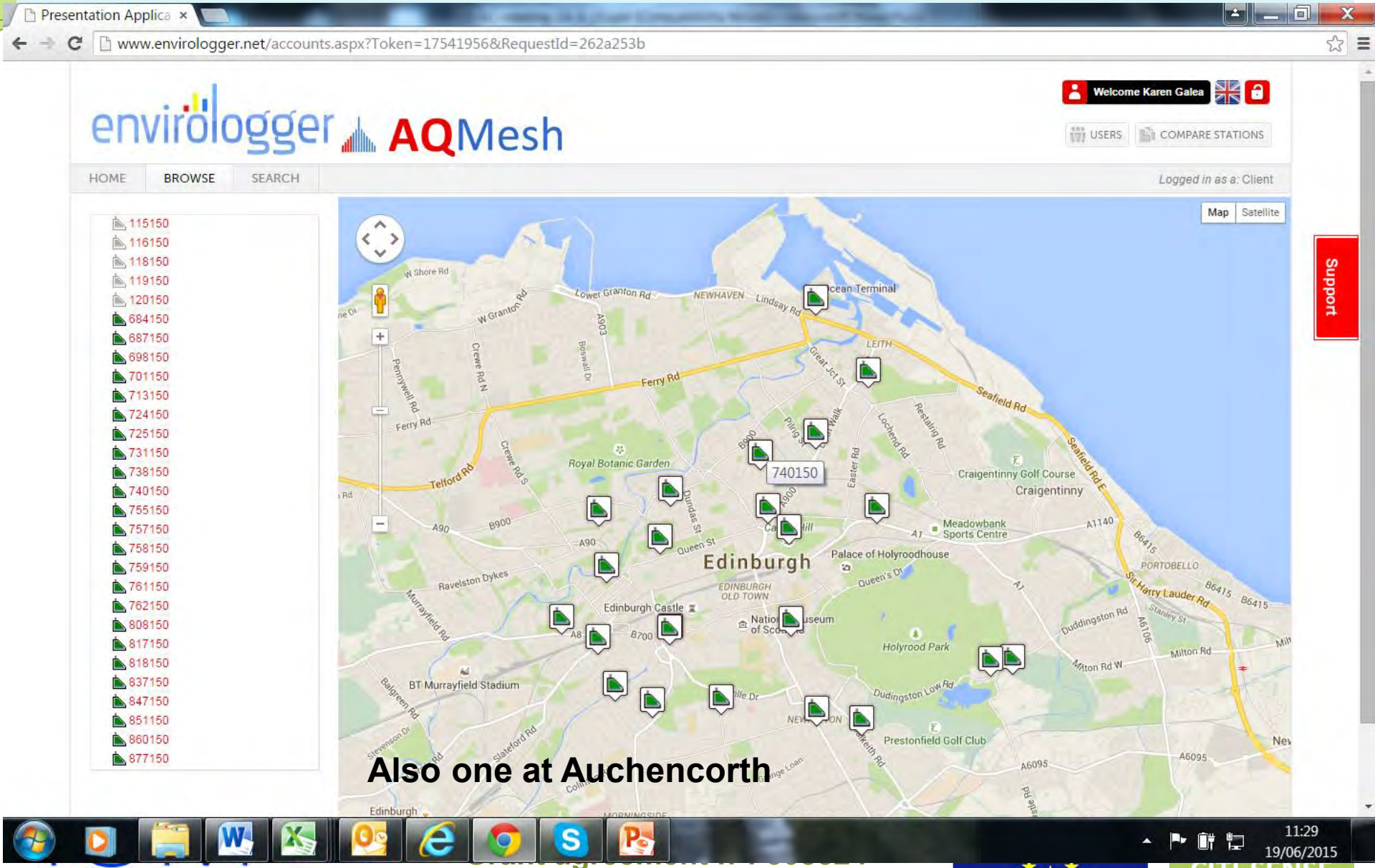
Where did we locate the pods?



Experiences

- Co-location at 5 reference monitoring sites
  - Particle count, NO, NO2, O3,noise level and peak - All pods within an area significantly different from each other
  - CO - No significant difference between pods at 3 sites, all significantly different at other two
  - Offset and slope adjustments applied to some, not all sensors, only valid for that sensor…..

- Deployment in Edinburgh
  - AQMesh pods remained in-situ (not stolen/ vandalized)
  - Battery life ~ 6 months (depends on measurement strategy; pollutants included)

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However, sensor failures occurred…..

Failure rate (%) 21

Type of sensor	Count	% failures
NO	9	35
NO2	3	12
O3	7	27
CO	7	27
TOTAL	26	

Location	Failures
Austria	33
UK (IOM)	26
Czech Republic	18
Slovenia	9
Norway	5
Spain	2
Serbia	2
Israel	1

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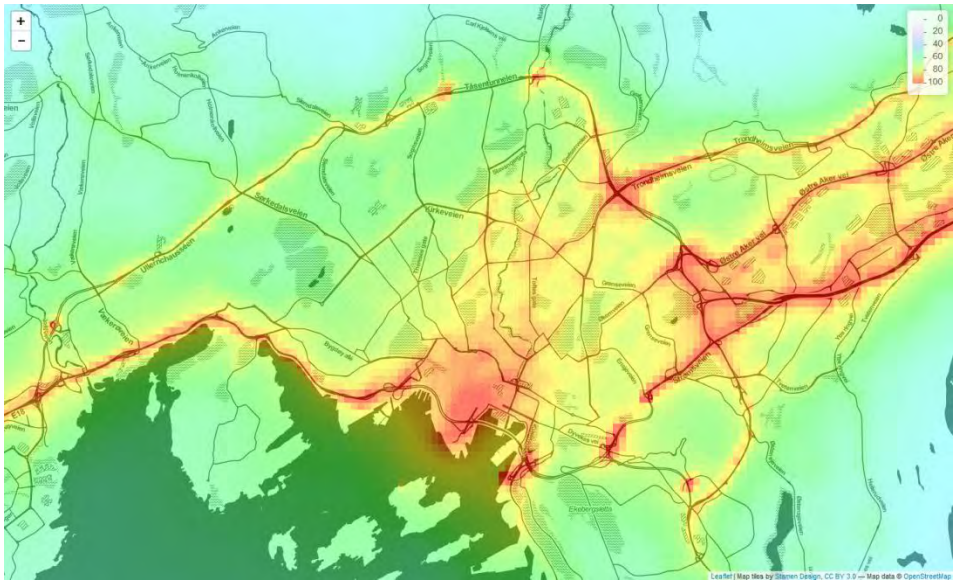
AQMesh pods – next steps…..

- Continued use in most of CITI-SENSE cities
- Being removed from Vienna and Edinburgh
- Redeployed elsewhere
  - Increase in numbers in cities where sensor failures not an issue
  - Development of data fusion maps



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Little Environment Observatories (LEOs)

- Portable ~8 x 10 x 4 cm, ~7 ounces
- NO, NO2, O3, temp, RH
- Designed for use with Android phone
  - ExpoApp communicates with LEO, reads and uploads the observations from the LEO
  - geolocation data, physical activity
- Data logged every 10 sec, uploaded every 1 mins (if mobile data available)

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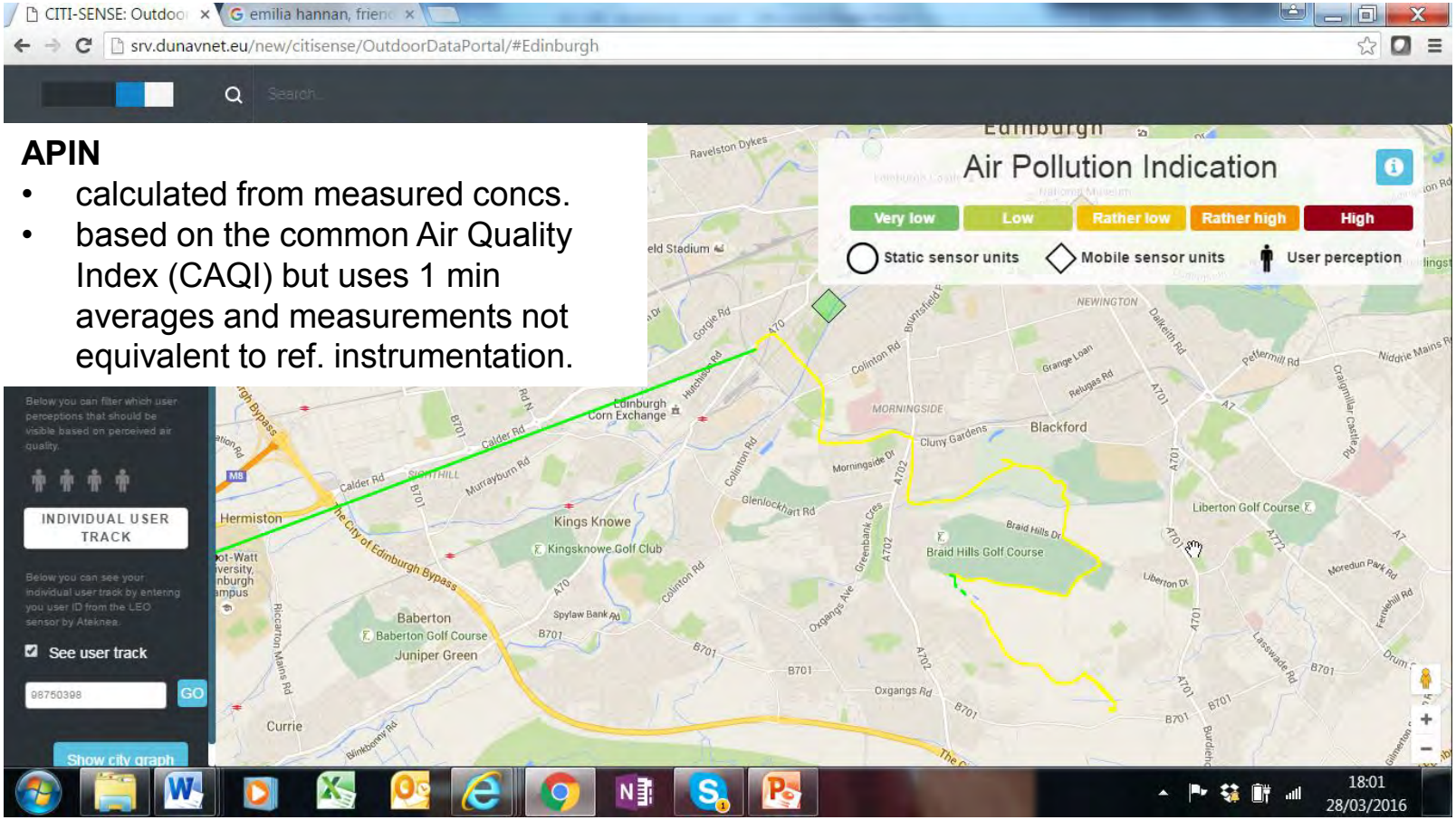
How is the data visualised?

APIN

- calculated from measured concs.
- based on the common Air Quality Index (CAQI) but uses 1 min averages and measurements not equivalent to ref. instrumentation.



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Some feedback from Ljubljana..

- Great but unstable –resolved with App updates
- No issues with privacy / confidentiality
- Concerns about wearing device in public places
- Wearable but would like it to be smaller
- "*if people .. more aware of different location of pollution it would make them change their daily routine …., people would maybe be more aware .. air is polluted .they are part of the cause".*

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Edinburgh citizens – what do they think and what do they want?

- Purpose: Questionnaire developed to obtain information on citizens perception of air quality in their cities.
- Implemented: http://edinburgh.citi-sense.eu
- Live: 21st Sep 2015 – till present
- Respondents to date: 76, some selected results

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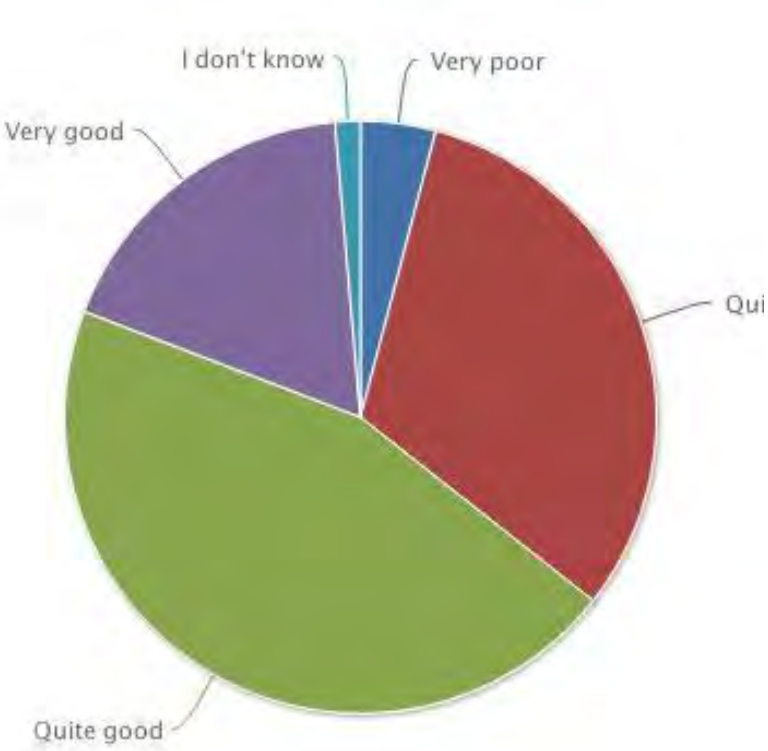
How would you describe AQ in Edinburgh generally?



- *Don't know enough to judge*
- *big contrast between areas - areas very good air quality & areas where air thick with exhaust or other fumes.*
- *Geography/weather*
- *Compares favourably with other places (difference with London massive)*
- *It's breaking legal limits*
- *Asthmatic, regularly affects me /*
- *Not causing me any health problems*

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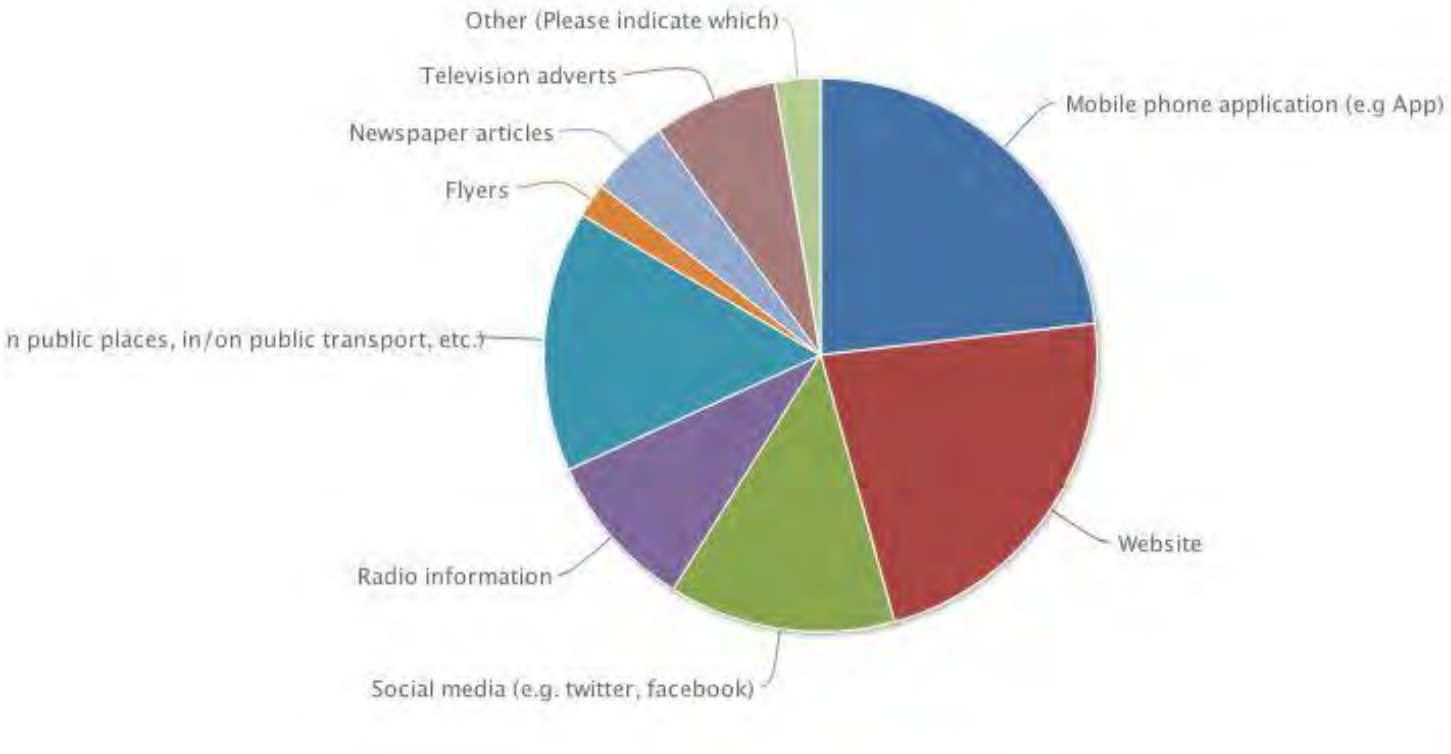
In which format would you prefer to receive AQ info.? (max. 3 options)



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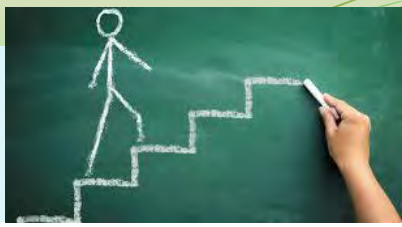
If could have a mobile phone App which informs about AQ, how important would the following features be?

	Essential (%)	High (%)	Medium and lower (grouped) (%)
An air quality index indicating if air quality is poor or good	48	23	29
Information on current air quality	43	35	22
Air quality in your immediate vicinity (i.e. where you are)	29	42	29
Notifications in case of increased air pollution	22	41	37
Numeric information on pollutant concentrations in the air	20	34	46
Information on forecasted air quality	19	35	46
Information on what to do to protect your health	19	30	51
Possibility to see the AQ levels in the routes you move around the city	17	39	44
Possibility to select cleaner routes to move in the city	15	33	52
Ability to see what other users have reported	13	13	74
Ability to report what you think the air quality is like	11	13	76
Information on past air quality	0	30	70

What next for CITI-SENSE in Edinburgh?



- Investigate products ‘empowerment potential’
- What do we mean by empowerment?

  ‘enhancing an individual’s or group’s capacity to make effective choices, effective in the sense of enabling them to transform those choices into desired actions and outcomes.

- Participants needed - trial products & give feedback

Visit stand for more info!

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Acknowledgements

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- CITI-SENSE WP2 local Advisory Committee
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