Introduction: air quality legislation, emission sources, health effects and Management

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Pollution kills. It aggravates cardiovascular and respiratory diseases and affects especially the young, old and sick. The EU has set health-based air quality limit values to protect human health, but the air quality in many European cities still exceeds these levels. The pollutants of particular concern are particulate matter (PM_{10}, $PM_{2.5}$) and NO_2 (emitted as NOx, i.e. both NO and NO_2), of which particulate matter is generally accepted as being of greater health impact – particularly the very small carbonaceous particles.

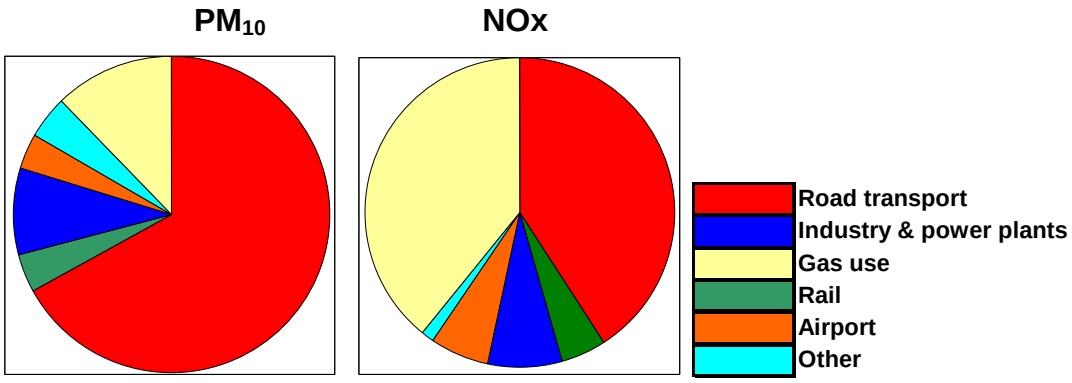
Table 1. European air quality standards for NO_2 and particulate matter

Pollutant	Averaging period	Limit Value	Date to be met
NO_2	1-hour	200μg/m^3 not be exceeded >18 times/yr	1/1/2010
	Calendar year	40μg/m^3	1/1/2010
PM_{10}	24-hour	50μg/m^3 not be exceeded >35 times/yr	1/1/2005
	Calendar year	40μg/m^3	1/1/2005
$PM_{2.5}$	Calendar year	25μg/m^3	1/1/2015
	Calendar year	20μg/m^3	1/1/2020
	Exposure reduction	20% urban background reduction	2010-2020

A key source of both PM and NOx is road vehicles, particularly in cities and towns where concentrations are higher. For PM, long range emissions (often also from road transport) are also a significant source, generally averaging around a third of the total PM concentrations, but varying with region and city. Other sources of both pollutants include power stations, industrial factories, construction, shipping, aircraft and its surrounding activities, domestic heating.

The example of London, given in figure 1 shows that at a local level, transport is by far the most important source to tackle. Many other cities and towns will be similar.

Figure 1. Urban emissions sources – example London (2003)



The EU, Governments and local authorities within Europe are taking action to meet these limit values, implementing air quality strategies. Air Quality Strategies assess the air quality situation and include a package of measures to reduce emissions from the various sources. They include:

For road transport

- EU vehicle emissions limits for PM and PM number
- Fuel standards
- Low Emission Zones (LEZs)
- Better, cleaner public transport
- Better landuse planning
- Less and smoother traffic
- Altered speed limits

For other transport

- Cleaner vehicles and other activities at ports and airports
- International action on ship and aircraft emissions

For non-transport

- Industrial regulation
- Controls on construction sites
- Domestic fuel bans and emissions standards
- Improving energy efficiency

Key mechanisms to achieve these actions include financial support for cleaner actions – for example tax incentives or grants - and regulation – for example emissions limits.

One key city-level measure being planned and implemented in over 70 cities in 8 countries in Europe are Low Emission Zones (LEZs), also referred to as Environment Zones. This is where the more polluting vehicles have restricted access to certain areas, through bans or charges. These are mostly for city centres on a permanent basis, but there are also LEZs for motorways or those in operation only at certain times of the day or at times of high pollution.

LEZs are operating or planned in cities as wide-ranging as London, with a population of 7 million and an area of 1600km^2, to Pleidelsheim in South West Germany with a population of 6300. There are many different 'models' of LEZ, to suit the different air quality issues, vehicle fleets, legal and political realities of the different countries or towns. In each country there is a often a

framework for LEZs, such as a common emissions standard, approach to vehicles affected, sticker, retrofit possibilities. Enforcement ranges from manual viewing of a windscreen sticker to camera observation of number plates and transponders.

All European LEZs use the Euro standards for emissions limits, which currently range from Euro 1 to Euro 4(PM), usually around Euro 2 or 3(PM). Most allow or encourage the retrofitting of certified diesel particulate filters to vehicles to enable older vehicles to achieve the set emissions standards for PM.

Those starting now to plan LEZs have the opportunity to 'pick and choose' from the models already in existence, learn from their experience and choose what would suit their situation. There is a significant advantage to having a common approach within the country and support from national Government. There is also advantage to having approaches similar to those already in existence, for example the same emissions standards as others, diesel particulate filter certification, or sticker scheme.

Further information on LEZs in Europe are available from www.lowemissionzones.eu, a website run by a European-wide LEZ Network supporting cities, ministries and regions operating and planning LEZs, operated by Sadler Consultants. This public website gives an updated list of LEZs around Europe, together with compliance mechanisms, particulate filters valid and background information on LEZs.

Figure 2. Homepage of www.lowemissionzones.eu (June 2008)

Session: LEZs: Introduction

Air Quality Health Effects, Legislation, Emission Sources, Management,

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Specialists in air quality policy

Why LEZs?
Health effects: Pollution kills

Air Pollution:

- Particularly affects very young, old, with heart & lung diseases
- Triggers asthma attacks, hospital admissions & days off sick
- Responsible 310 000 premature deaths in Europe each year
  - more than caused by road accidents
- Its human health damage cost the European economy €427 - €790 billion per year

Particularly Particulates

- Particulate matter (PM) one of most harmful ambient pollutants to health
- Within PM, smaller, carbonaceous particles kill most effectively
- Sources: Combustion processes & particularly diesel combustion
  - also emitted where the people live
- No impact threshold
  - i.e. no safe level

EU AQ Standards

Pollutant	Averaging period	Limit value*	Date by which value is to be met
Benzene	Calendar year	5 µg/m^3	1 January 2010
CO	8-hour, rolling basis	10 mg/m^3	1 January 2005
Lead	Calendar year	0.5 µg/m^3	1 January 2005 or, in specific cases, 1 January 2010
Nitrogen dioxide (NO_2)	1-hour	200 µg/m^3 not exceeded > 18 times a calendar year	1 January 2010
	Calendar year	40 µg/m^3	1 January 2010
Ozone (O_3)	Maximum daily 8-hour mean	120 µg/m^3, not exceeded days / calendar yr averaged over 3 yrs	Target value for 2010
(PM_{10}), Gravimetric**	**24-hour**	**50 µg/m^3, not exceeded > 35 times a calendar year**	**1 January 2005**
	Calendar year	**40 µg/m^3**	**1 January 2005**
$PM_{2.5}$ Gravimetric**	**Calendar year**	**25 µg/m^3**	**1 January 2015**
	Calendar year	**20 µg/m^3**	**1 January 2020**
	Exposure reduction	**20% urban background reduction**	**Between 2010 & 2020**
Sulphur dioxide (SO_2)	1-hour	350 µg/m^3, not exceeded > 24 times a calendar year	1 January 2005
	24-hour	125 µg/m^3, not exceeded > 3 times a calendar year	1 January 2005
Limit Values for the protection of vegetation (NOx) and ecosystems (SO_2)			
NOx	Calendar year	30 µg/m^3	19 July 2001
SO_2	Calendar year & winter (1 Oct to 31 Mar)	20 µg/m^3	19 July 2001

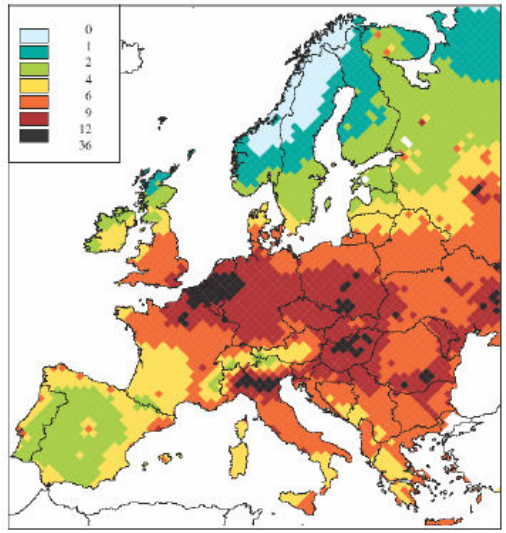
* Limit Value is legally binding on member states
** Gravimetric refers to the method of measuring PM_{10}

How is Europe doing?

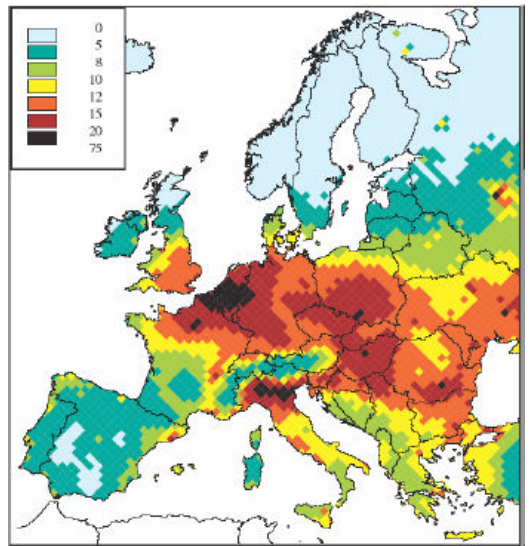
Action plans needed (2003)

Member State	NO_2 annual action plans	PM_{10} daily action plans	PM_{10} annual action plans
Austria	6	10	1
Belgium	1	10	9
Germany	16	20	8
Denmark	1	0	0
Greece	2	4	4
Spain	2	24	14
Finland	0	0	0
France	11	5	4
Ireland	0	0	0
Italy	33	46	35
Luxembourg	1	0	0
Netherlands	9	6	1
Portugal	1	6	2
Sweden	0	0	0
UK	35	18	10
Czech Republic	0	12	6
Estonia	0	1	0
Lituania	0	3	1
Slovenia	0	4	3
Slovak Republic	0	9	9

Loss of life from $PM_{2.5}$ (mths)



Man-made $PM_{2.5}$



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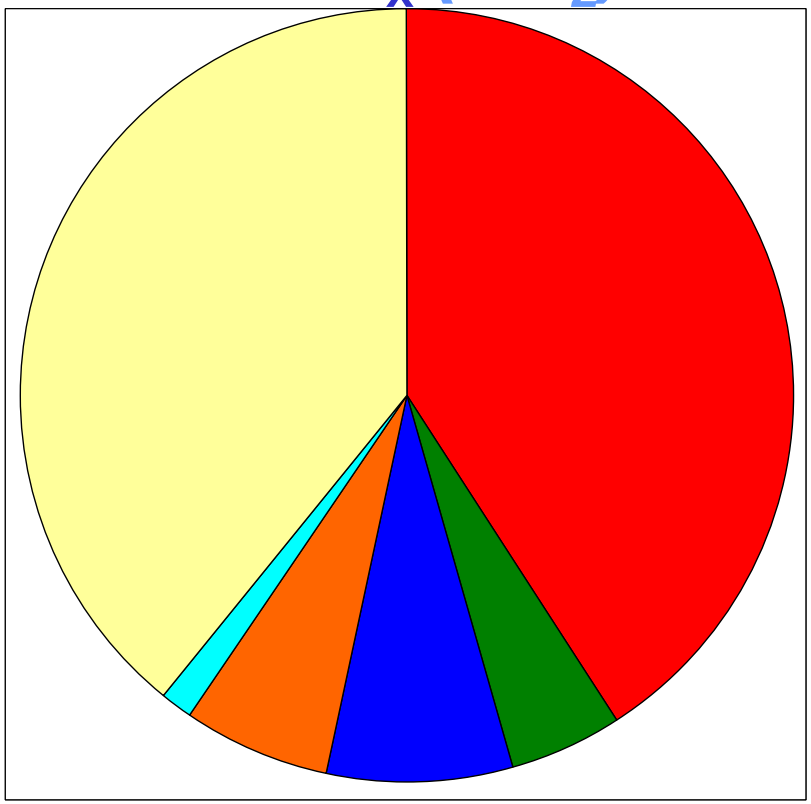
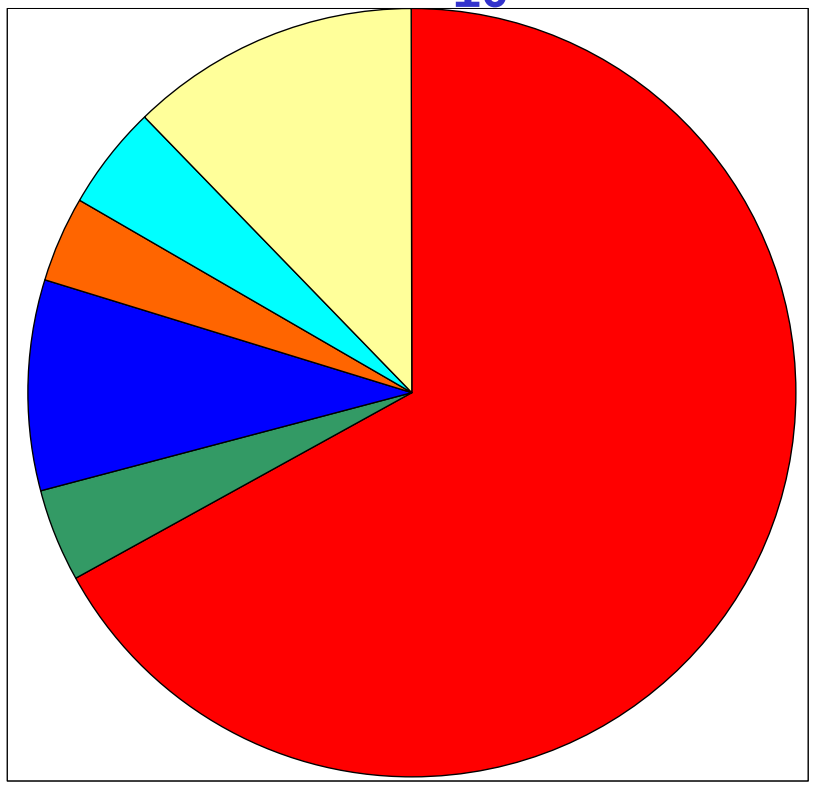
Local urban emissions sources: London (2003)

NO_x *(NO_2)*



PM_{10}

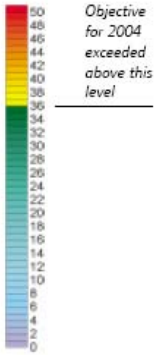


- Road transport
- Industry & power plants
- Gas use
- Rail
- Airport
- Other

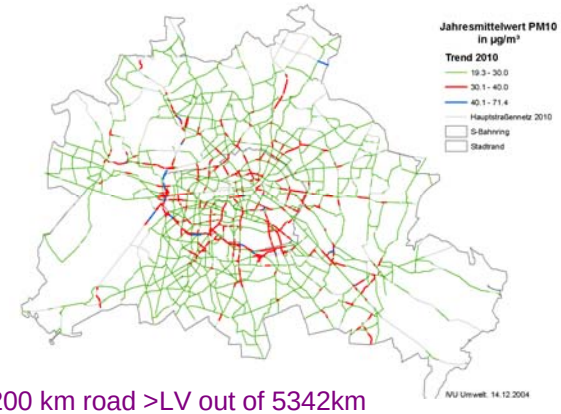
Main local source: Road Transport

Air Quality Strategies

London daily exceedences 2004

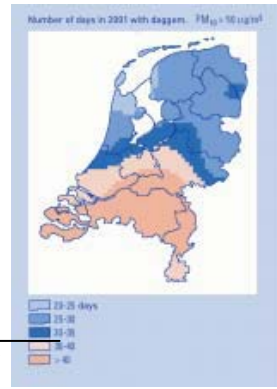


Berlin annual ave PM_{10} 2010

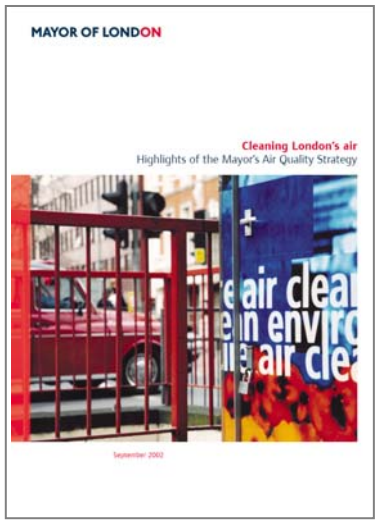


200 km road >LV out of 5342km

Dutch daily exceed. PM_{10} 2001



Over LV level



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Measures include:

- Transport
  - European vehicle and fuel standards
  - Better & cleaner public transport
  - Less & smoother traffic, altered speed limits
  - Better landuse planning
  - LEZs
  - Cleaner vehicles & other activities at ports & airports
  - international action on ship & aircraft emissions
- Financial support for cleaner actions
- Non transport
  - Controls on construction sites
  - Industrial regulation
  - Domestic fuel bans & emissions standards
  - Improving energy efficiency
- …….
- ……

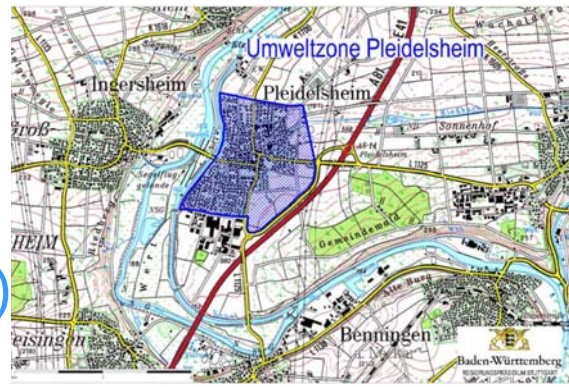
LEZs in Europe

There are over 70 LEZs in operation or planning Europe, in 8 countries. More will follow

- 5 in operation Sweden, 3 since 1996
- 4 regional in operation in North Italy, covering many towns, plus an additional scheme in Milan
- 33 confirmed in Germany, 12 in operation
- 1 in operation in UK
- 8 in operation + 9 confirmed in the Netherlands
- 5 confirmed in Denmark
- 3 in planning in Norway
- 1 under consideration in Spain
- Most have 2 phases – Phase 2 having greater effect
- All are based on Euro standards
- The most are focused on particulate matter - eg Euro 3(PM)

LEZs for large cities - and smaller towns

- London
  - population 7 million, area 1600km^2
  - Heavy vehicles 2008 Euro 3 (PM)
    2012 Euro 4 (PM)
    heavier vans 2010 Euro 3 (PM)
  - Camera enforced, 300 €/day if not meet standards



- Pleidelsheim (B-W Germany)
  - population 6300
  - all diesel vehicles July 2008 Euro 2 (PM)
    Jan 2012 Euro 3 (PM)
  - manual enforcement

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Different LEZ models (1)

- Lots to chose from. Depends on legal, political situation & size of problem
- Current standards: Most ~Euro 3, but ranging from Euro 1 to Euro 4(PM), tightening ~ 2010/12
- Standards are differently expressed
  - Euro X(PM), pre-Euro Y must retrofit
- Most are a vehicle ban
  - Milan & Norway are charges for more polluting vehicles
  - London uses a charge mechanism, but acts as a ban with exceptions
- Most allow/encourage retrofits
  - Denmark 80% PM reduction
  - Sweden & Norway no retrofits
  - Others to meet the Euro standard (PM)
- National support/structure is easier
- Regions have grouped to reduce competition
  - eg north Italy, Ruhr in Germany
- If cars affected more likely to reduce traffic

Different models (2)

- Vehicles affected
  - From HGV only through to all vehicles (including motorcycles)
- Legal basis
  - Local laws or national framework, with cities joining under local law
  - Local law enabled with ‘pilot scheme’
  - Charge mechanism (or ‘environmental tax’)
  - City centre access permit conditions
- Enforcement
  - Manual (sticker local or national)
  - Camera and database
  - Transponder (similar to continental motorways) with other options
- Area
  - Entire agglomeration - Groups of areas
  - City centre - Specific streets
- ‘Motorway LEZ’
  - Can be allowed by the EU if only affects few (eg Euro 1, 2) vehicles
  - Including emissions in night-time lorry ban

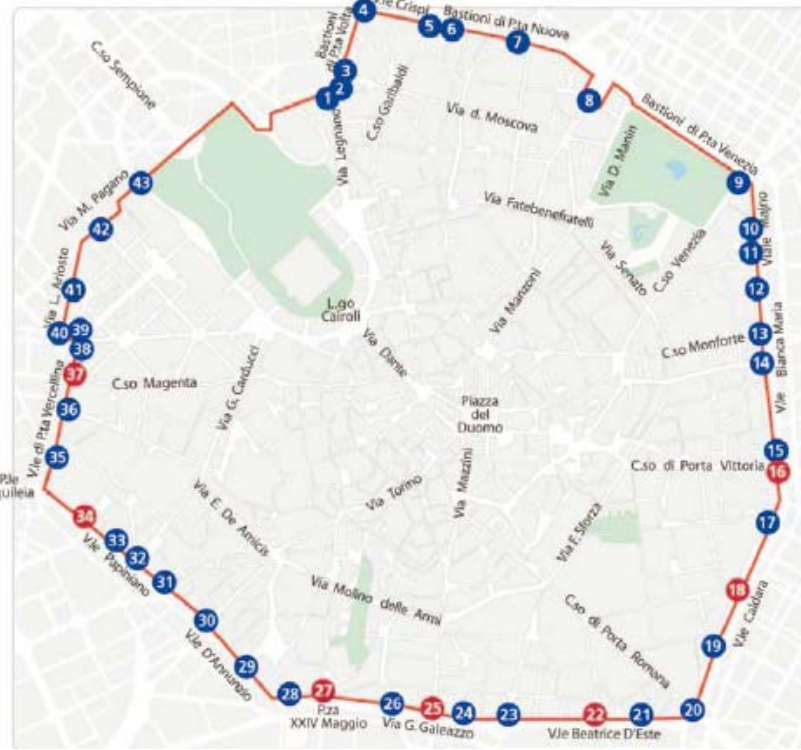
Different models (3)

- Different aspects
  - London: long lead-time; lots of consultation; few exemptions (charge)
  - Germany: some cases short lead-time; exemptions for ‘hardship cases’
  - Netherlands: negotiation with transport operators & national covenant
  - North Italy: Time-restricted LEZs (winter, peak) allows ‘poorer ops entry’
  - Milan: implement charge initially as pilot for a year, charge per entry
  - Norway: income from charge → grants to clean
  - Sweden: Enforced on main roads
- Similar standards in a country
  - Germany: national framework, but cities/regions choose standards
  - Sweden: Same scheme but separate stickers per city
  - Italy: different standards in different regions & towns; separate Milan scheme
  - Recommend:
    - same emissions standards
    - same stickers if having stickers

Italy

- 4 regional LEZs under an agreement of the North Italian regions for large number of towns
- All vehicles, including motorcycles
- Time limited, and only in winter
- E.g: South Tirol
  - 2nd November - 30th March for 10 towns
  - 7:00 – 10:00 & 16:00 – 19:00, Monday - Friday
  - bans all pre-Euro 0 and Euro 1 vehicles, & all 2-stroke motorcycles
- Time dependence allows those on lower incomes to still access the city, but adds complexity
- Retrofitting of filters is encouraged
- Funding to assist retrofit & those on low incomes

Milan



- Ecopass scheme since 1.1.08
- ***In addition*** to LEZ controls in winter
- More polluting vehicles charged for entry 7:30-19:30
  - Free: Class 1
    - AFV; gas, electric, hybrid
  - Free: Class 2
    - Petrol: cars Euro 3+
    - Diesel: cars & GV Euro 4+ or with filter
  - 2€/day: Class 3
    - Petrol: Euro 1, 2
  - 5€/day: Class 4
    - Petrol: cars Euro 0; GV Euro 1, 2;
    - Diesel: cars Euro 3; GV Euro 3; buses Euro 4 & 5
  - 10€/day: Class 4
    - Diesel: cars Euro 0; GV Euro 0-2; bus Euro 0-3
- Resident & multiple entry discounts (non-commercial vehicles only)

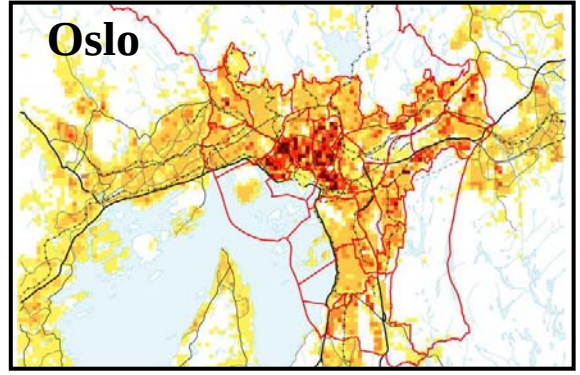
The Netherlands

- 8 in place, ~9 more starting 2008
- National approach:
  - Local schemes under national agreement until national law in place, together with grants
  - Scheme negotiated with operators
  - Gradual enforcement until all cameras etc in place

- Heavy duty only
  - Until 2010
    - Euro 1 & less banned
    - Euros 2 & 3 require filter
    - Euro 4, 5, 6, EEV, gas, hydrogen, E85 allowed in
  - After 2010 are:
    - Euro 2 & less banned
    - Euro 3 require filter & must be <8 years
    - Euro 4, 5, 6, EEV, gas, hydrogen, E85 allowed in
  - After 2013
    - Only Euro 4, 5, 6, EEV, gas, hydrogen, E85 allowed in

Denmark

- National framework for 5 municipalities
- All diesel vehicles over 3.5T
  - After 1 September 2008
    - Vehicles >7 years old must fit DPF (80% PM_{10} reduction, E3→E4)
    - Or meet Euro 3 (PM)
  - After 1 July 2010
    - Vehicles >4 years old must fit DPF
    - Or meet Euro 4 (PM)



Norway

- In planing for 3 towns 2009/10
- Works on an ‘Environmental Tax’ basis
- Vehicles <Euro 4 pay

	3.5-12T	>12T
Euro 2 & 3	1400 €	2900 € / year
Euro 0 & 1	2500 €	5000 € / year

- Camera and transponder enforced, building on motorway tolls and studded tyre charges
- Legislation currently for consultation

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‘Motorway LEZs’

- Austria & north Italy have ban for Euro 0, 1, 2 lorries on certain motorways
  - Austria on 89km of the A12 from Kufstein to Zirl
    - Trailer lorries >7.5T banned Euro 0 & Euro 1 since 1.1.2007, Euro 2 from 1.11.2008.
    - Lorries without trailer >7.5T banned for Euro 0 & Euro 1 from 1.11.2009
  - Austrian currently A12 has a night-ban for lorries less than Euro 4
  - Sectoral goods ban May 08

  - Italy on 180km of the A22
    - Ban Euro 0 & 1 lorries
    - Considering banning Euro 2 in the future

Low Emission Strategies

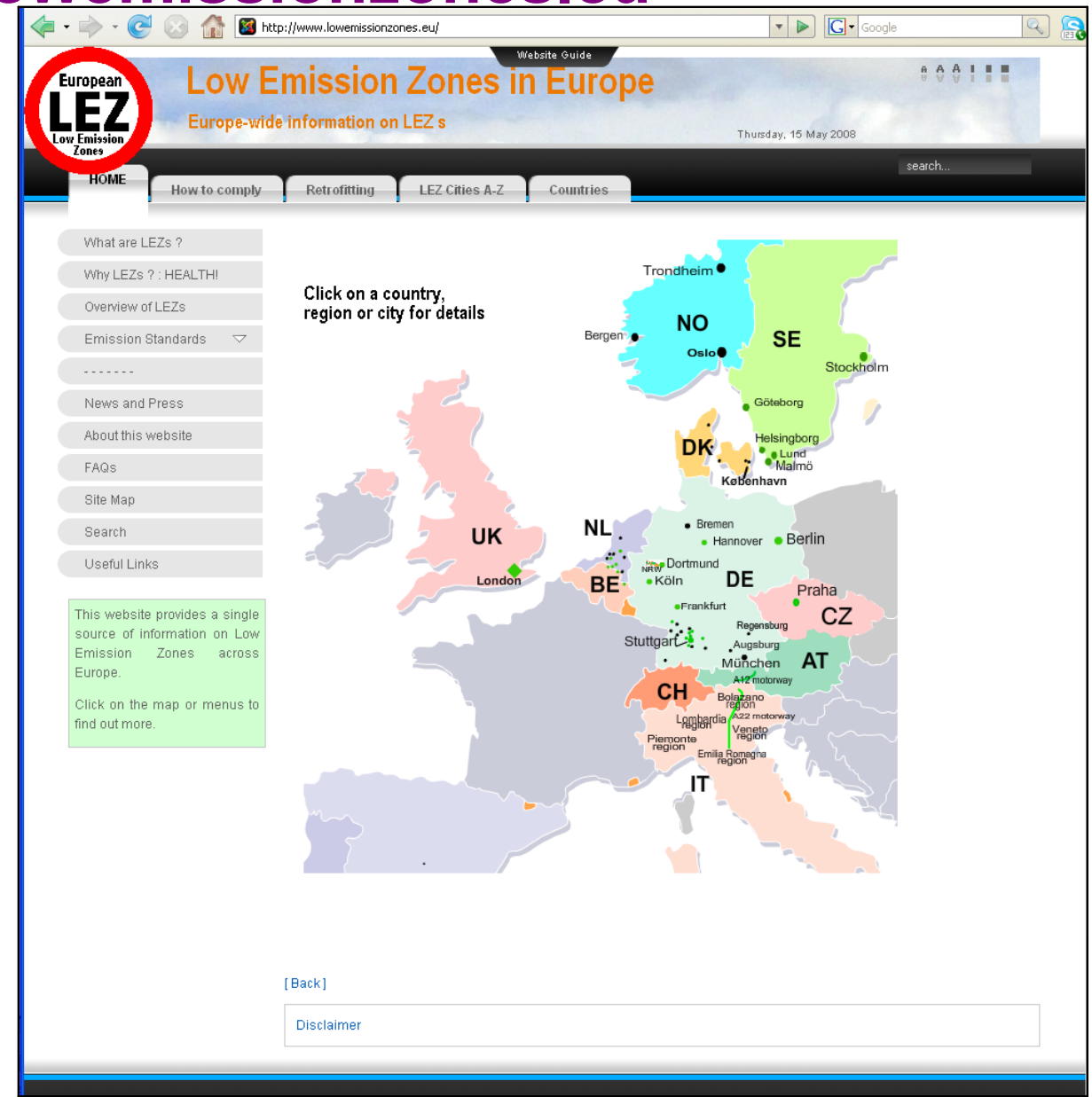
- Through the planning system
- Allow tighter standards for use & build of new developments
- Include construction schemes
- UK guidance in preparation

Information on LEZs in Europe

www.lowemissionzones.eu

One-stop source

Details in 1 or 2 clicks from homepage



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