

Source Control Options for Reducing Emissions of Priority Pollutants from Urban Areas - Source Characterisation

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The ScorePP Project



- A Specific Targeted Research Project (STREP)
- Funded by the European Commission under the 6th Framework Programme (4th Call), sub-priority 1.1.6.3 "Global Change and Ecosystems"
- Duration: 1 Oct 2006 + 36 months
- Budget: 3.6 M EUR, 2.6 M EUR from the EC
- 9 partners
- www.scorepp.eu



Partners and case cities





Partners:

1. DTU, Denmark
2. MU, UK
3. UGent, Belgium
4. AR, France
5. ENVICAT, Belgium
6. UL, Slovenia
7. ESTUDIS, Spain
8. MF, Sweden
9. modelEAU, Canada

Case cities:

- Stockholm, Sweden
- St. Malo, France
- Prague, Czech Republic
- Quebec, Canada
- St. Sebastian, Spain



Main ScorePP objectives

Develop comprehensive and appropriate source control strategies

that authorities, cities, water utilities and chemical industry can employ to

reduce emissions of priority pollutants from urban areas



Text in work programme

Article 16 of the Water Framework Directive has put in place a mechanism through which a list of **33 priority pollutants** has been created.

From this list, a group of **11 priority hazardous substances** has been identified and which will be subject to cessation or phasing out of discharges, emissions and losses within an appropriate timetable that shall not exceed 20 years.

The proposed action will investigate alternative technologies, management options and monitoring systems for source control of priority substances.

A **multi-criteria comparison with end-of-pipe solutions** will be carried out and the **impact of different substitution options** should be assessed.



Background of the substances on the Water Framework Directive

- The substances were chosen based on environmental quality standards and emission control measures established in the mid 1990s and ranked according to their measured concentrations or estimated concentrations (using production and use pattern, MacKay level 1 modelling and biodegradation) in water or sediment and PNEC, BCF and CMR data.
- This work resulted in the **WFD** with a list of 33 priority substances.

The 33 priority substances

<p>Alachlor</p> <p>Anthracene</p> <p>Atrazine</p> <p>Benzene</p> <p>Brominated diphenylethers</p> <p>Cadmium and its compounds</p> <p>C₁₀₋₁₃-chloroalkanes</p> <p>Chlorfenvinphos</p> <p>Chloroform</p> <p>Chlorpyrifos</p>	<p>Fluoranthene</p> <p>Hexachlorobenzene</p> <p>Hexachlorobutadiene</p> <p>Hexachlorocyclohexane</p> <p>Isoproturon</p> <p>Lead and its compounds</p> <p>Mercury and its compounds</p> <p>Naphthalene</p> <p>Nickel and its compounds</p> <p>Nonylphenols</p>	<p>Octylphenols</p> <p>Pentachlorobenzene</p> <p>Pentachlorophenol</p> <p>Polyaromatic hydrocarbons</p> <p>Simazine</p> <p>Tributyltin compounds</p> <p>Trichlorobenzenes</p> <p>Trifluralin</p>
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The 8 substances related to the EQS

<p>Aldrin</p> <p>Carbontetrachloride</p> <p>para-para'-DDT</p> <p>Dieldrin</p>	<p>Endrin</p> <p>Isodrin</p> <p>Tetrachloroethylene</p> <p>Trichloroethylene</p>	
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The 12 priority hazardous substances or groups

Anthracene

Brominated diphenylethers

Cadmium and its compounds

C₁₀₋₁₃-chloroalkanes

Hexachlorobenzene

Hexachlorobutadiene

Hexachlorocyclohexane

Pentachlorobenzene

Polyaromatic hydrocarbons

Tributyltin compounds

Mercury and its compounds

Nonylphenols

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The ScorePP Idea

Limiting release through:

- Substitution
- Minimising release from products
- Legislation and regulations
- Voluntary use reductions

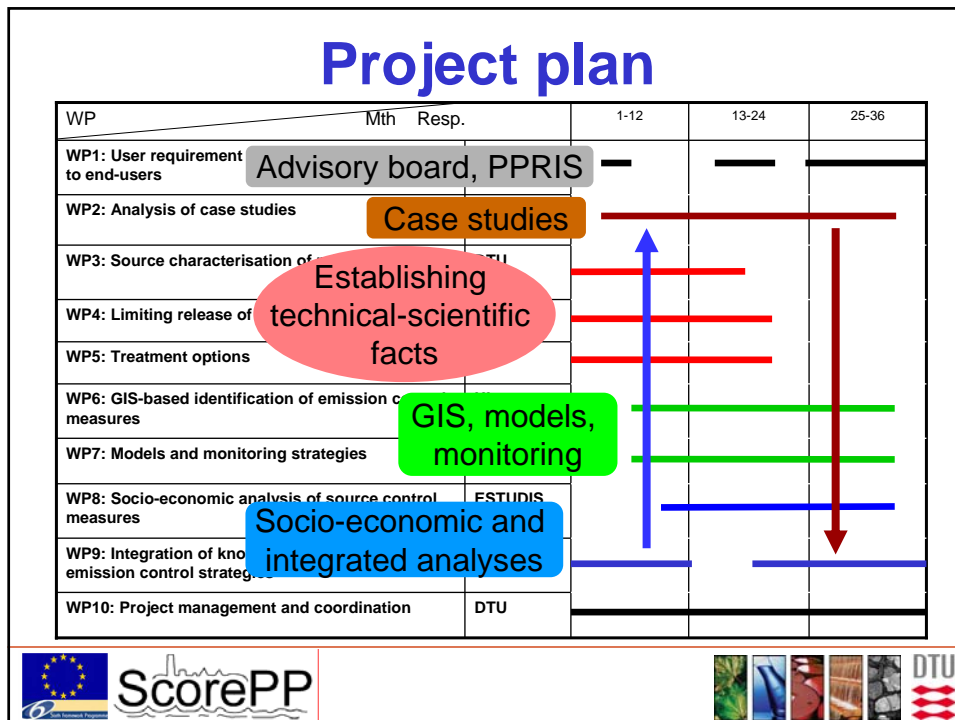
Treatment options:

- Stormwater BMPs
- Household treatment & reuse of WW
- On-site industrial treatment
- WWTPs
- Sludge disposal

Sinks:

- Primary: Surface water (WFD)
- Secondary: Sediments, soils/groundwater, humans, ...

Example: Combined system:



Main focus during 1st half year

- Overall strategy for data management on sources, releases and loads of priority pollutants (PPs)
 - "Emission Strings"
- Compilation of information on PPs
 - Identification of chemicals listed in the WFD (PS/PHS) and the EQS proposal (=> the "expanded" PP list)
 - Compilation of basic information about these PPs
 - Share this information among consortium members and others (=> Database with public access)



Requirements related to data management

- Structure should allow integration of collected PP information on sources, releases and loads, potential mitigation options, emissions into the environment, etc.
- Enable connection to important data sources describing the production and transport of goods and performance of services in the EU member states;
- Allow connection to data sources describing the economic and financial aspects of different activities in the EU;
- Harmonization with existing pollution emission reporting systems used in the EU.



Source characterisation based on "Emission Strings"

- "Emission Strings" combine three classification levels
 - CAS numbers, uniquely identifying each substance
 - NOSE-P classification codes, uniquely identifying emission processes for a substance
 - NACE classification codes, uniquely identifying specific economic activities related to each emission process
- This approach will allow data to be obtained from Eurostat, and extrapolation to the whole of Europe should be possible



Processes associated with Emission Strings

- **Some examples:**
 - **Models used to quantify the release of PPs from emission sources (e.g. as used in the EU Technical Guidance Document for risk assessment of chemicals)**
 - **Legal constraints associated to a specific Emission String or to all Emission Strings in which a specific substance is listed**
 - **Substitution options or voluntary use reductions targeting specific PPs within a specific economic activity**



Information about PPs to be included in the database

Physico-chemical properties

Environmental effect

Legislation

Environmental fate

Environmental presence

Physico-chemical properties

- Chemical IDs; CAS#, EINECS, Merck #
- Molecular formula
- Physical appearance
- Density (ρ), g/mL
- Molecular weight (M_w), g/mole
- Melting point (T_m), °C
- Boiling point (T_b), °C
- Solubility in water (S_w), mg/L
- Lipid solubility of neutral species ($\log K_{ow}$)
- Lipid solubility of ionized species ($\log D_{ow}$)
- Vapour pressure, mm Hg
- Acid dissociation constant (pK_a)
- Henry's law constant (K_h), atm \times m³/mole
- Diffusion coefficient, m²/d

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Environmental fate

- Distribution between organic carbon and water (K_{oc}), L/kg
- Distribution between solids and water (K_d), L/kg
- Complex formation (K_C)
- Photodegradation ($t_{1/2}$), d
- Oxidation ($t_{1/2}$), d
- Hydrolysis ($t_{1/2}$), d
- Aerobic biodegradation ($t_{1/2}$), d
- Anaerobic biodegradation ($t_{1/2}$), d
- Yield of growth on chemical

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Environmental presence

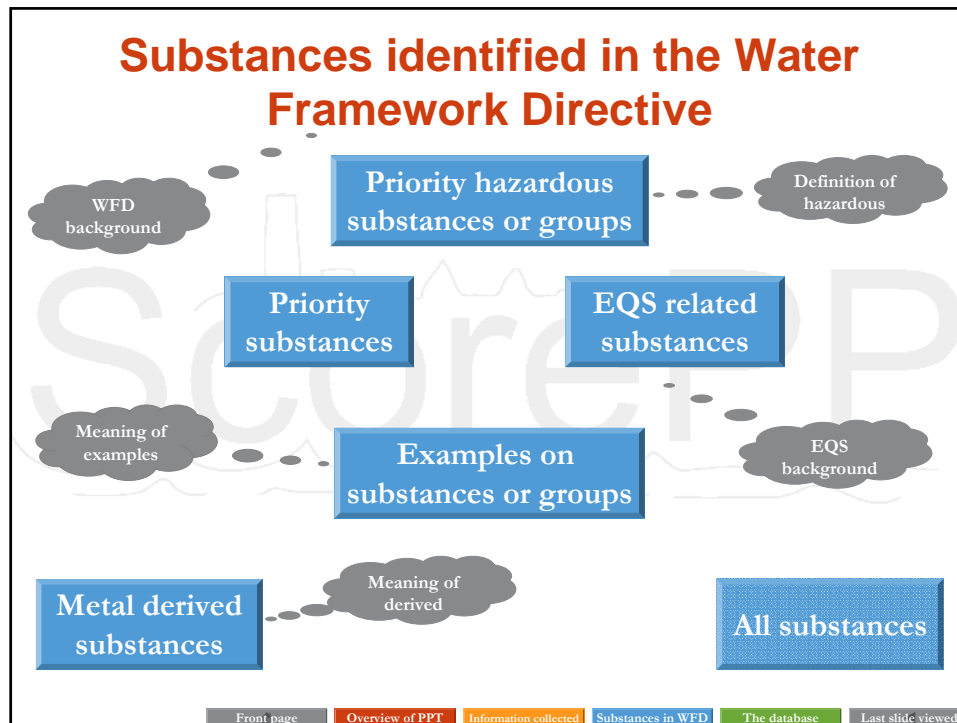
- Surface water; rivers, lakes, harbours, streams, lagoons, wetlands, canals, reservoirs, estuaries etc.
- Porewater (soil or sediment)
- Suspended sediment
- Sediment
- Soil

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Legislation/regulations

- EU legislation
- Case city country legislation
- Risk and safety phrases
- Classification
- Symbols
- Peak concentration limits
- Average concentration limits
- Restricted use
- Ban

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How the organometallic substances were derived

- The metals on the WFD list of substances are listed as e.g. “Lead and its compounds”
- In this task the participants have thus agreed on the ionic species and a selection of organometallic substances to extend the list from just the metallic forms to include some of the many organometallic substances as well
- The included organometallic substances were selected according to their relevance as they appeared in the [US National Library of Medicine, Toxnet - Hazardous Substances Data Bank](#) and through expert judgements made by the participants

Examples of substances as groups

Octylphenols
Para-tert-octylphenol

Hexachlorocyclohexane
gamma-isomer, Lindane

Polyaromatic hydrocarbons
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Indeno(1,2,3-cd)pyrene

Tributyltin compounds
Tributyltin-cation

Trichlorobenzenes
1,2,4-trichlorobenzene

Endosulfan
Alpha-endosulfan

Nonylphenols
4-(para)nonylphenol

para-para'-DDT
orto-para'-DDT
para-para'-DDE
para-para'-DDD

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The metal derived substances

Lead and its compounds
Diethyldimethyllead
Ethyltrimethyllead
Methyltriethyllead
Tetraethyl lead
Tetramethyl lead

Mercury and its compounds
Diethylmercury
Dimethylmercury
Methylmercury
Phenylmercuric acetate

Tributyltin compounds
Bis(tributyltin) oxide
Tetra-N-Butyltin
Tributylchlorostannane
Tributyltin methacrylate

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All 67 substances

Alachlor	Endrin	Octylphenols
Aldrin	Fluoranthene	Para-tert-octylphenol
Anthracene	Hexachlorobenzene	Pentachlorobenzene
Atrazine	Hexachlorobutadiene	Pentachlorophenol
Benzene	Hexachlorocyclohexane	Polyaromatic hydrocarbons
Brominated diphenylethers	gamma-isomer, Lindane	Benzo(a)pyrene
Cadmium and its compounds	Isodrin	Benzo(b)fluoranthene
Carbontetrachloride	Isoproturon	Benzo(g,h,i)perylene
C ₁₀₋₁₃ -chloroalkanes	Lead and its compounds	Benzo(k)fluoranthene
Chlorfenvinphos	Diethyldimethyllead	Indeno(1,2,3-cd)pyrene
Chloroform	Ethyltrimethyllead	Simazine
Chlorpyrifos	Methyltriethyllead	Tetrachloroethylene
para-para-DDT	Tetraethyl lead	Tributyltin compounds
orto-para'-DDT	Tetramethyl lead	Tributyltin-cation
para-para'-DDE	Mercury and its compounds	Bis(tributyltin) oxide
para-para'-DDD	Diethylmercury	Tetra-N-Butyltin
DEHP	Dimethylmercury	Tributylchlorostannane
1,2-dichloroethane	Methylmercury	Tributyltin methacrylate
Dichloromethane	Phenylmercuric acetate	Trichlorobenzenes
Dieldrin	Naphthalene	1,2,4-trichlorobenzene
Diuron	Nickel and its compounds	Trichloroethylene
Endosulfan	Nonylphenols	Trifluralin
Alpha-endosulfan	4-(para)nonylphenol	

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Current status of the project

- Inherent properties relating to environmental fate, presence and legislative issues have been collected for 67 PPs
- Investigations of different mitigation options are in progress with some completed e.g. BMPs for removal of stormwater pollutants
- Innovative approach to managing data sources, the PP loads and available mitigation options has been prepared combining CAS, NACE and NOSE-P classifications



Future challenges

- To connect the developed data management system with modelling aspects (including dynamic urban scale source flux models) and with the preparation of emission control strategies in the case city studies
- To optimise a multi-criteria comparison of source control versus end-of-pipe mitigation options in relation to their economic, social and environmental options
- To establish a productive dialogue with important stakeholders in the area of emission control of PPs

