CHALLENGES IN WATER POLLUTION MONITORING AND POLLUTION ASSESSMENT, CONTROL AND ABATEMENT: A PERSPECTIVE

Challenges

- Natural contamination
  - Fluorides
  - Arsenic
  - High TDS

  (Large part of country is affected. Human health issue)
- Industrial Pollution
  - New pollutants
  - Evolving standards
  - Consistent performance of ETP

Definitions

- Water Act: "pollution" means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms;
- "trade effluent" includes any liquid, gaseous or solid substance which is discharged from any premises used for carrying on any [6]["Industry, operation or process, or treatment and disposal system" other than domestic sewage.
- EP Act: "environment" includes water, air and land and the inter- relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property;
- "environmental pollutant" means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment;
- "environmental pollution" means the presence in the environment of any environmental pollutant;
- WHOLESOMENESS

CETP

- Many in operation
- Hardly any example of consistent compliance
- Even occasional performance???
- Issues many?
- Problems many?
- Concerns many?
- Issues: management, composition of waste, treatment technology, disposal etc…….

Policy paradigms

- Whether non-compliance is cheaper, rewarding and convenient?
- It should be other way round
- Essence of ease of Business is to avoid unfair business practices
- Unfair advantage to non-compliance will be a stumbling block in promotion of sustainable industrialization

Objectives of Water Quality Monitoring

- Objective is linked to ‘best use of water’ or ‘intended use of water’ at a location/reach
- The designated use in that reach (CPCB’s classification)
- WQ goals (what we need to achieve)
- WQ criteria (why we need to achieve a specific level of WQ parameters)
- WQ Standard (prescriptive and legally supported translation of the WQ criteria)
- Targets are then set based on
  - Techno-economic feasibility of achieving the standard (possible to reach x level)
  - Resources available

But, why monitor in the first place?

- What do we achieve by monitoring Water Quality (WQ)?
- What are our WQ criteria and legal standards?
- What are our WQ Goals (what do we want to achieve)?
- Are parameters we sample are in line with criteria, standards and objectives?
- What should be monitoring frequency sufficient?
- Are sampling and analysis protocols are available and followed (the right practice and reference method)?
- Is QA/QC done on data (e.g. replicating sample, missing values, outliers, statistical analysis like control charts etc.)?

Water Quality Monitoring Network

- **Setting Water Quality Monitoring Objectives**
- **Assessment of Resources Availability** - Laboratory facilities and competence - Transport - Manpower –adequate number and competence
- **Reconnaissance Survey - Map of the area** - Background information - Human activities - Potential polluting sources - Water abstractions and uses - Hydrological information - Water regulation
- **Network Design - Selection of sampling** locations - Optimum number of locations - Parameters to be measured - Frequency of sampling - Component to be samples – water, sediment or biota
- **Sampling - Representative sampling** - Field testing - Sample preservation and transport
- **Laboratory Work** - Laboratory procedures - Physical, chemical analysis - Microbiological and biological analysis
- **Data Management** - Storage - Statistical analysis - Presentation - Interpretation - Reporting
- **Quality Assurance** - Production of reliable data - Quality control - Internal AQC - External AQC

Analysis of data?

- To “extract” “hidden features” from the data
- To see a bigger picture! (new pollutants, new sources of pollution)
- To assess trends (linking to activities in surrounding)
- To check compliance (????)
- To serve as early warning system
- To facilitate decision making process on managing water resource and its use
- To facilitate data communication stakeholders

Uniform water quality monitoring protocol

- Provides a mechanism to streamline and inter-cordination among various monitoring agencies
- Has a wide mandate including analysis and interpretation of data
- Identification of Hot spots and devising action plans
- Entire data is effectively used…….public domain
- Notification under EP Act, hence has a mandatory nature

Emerging Contaminants

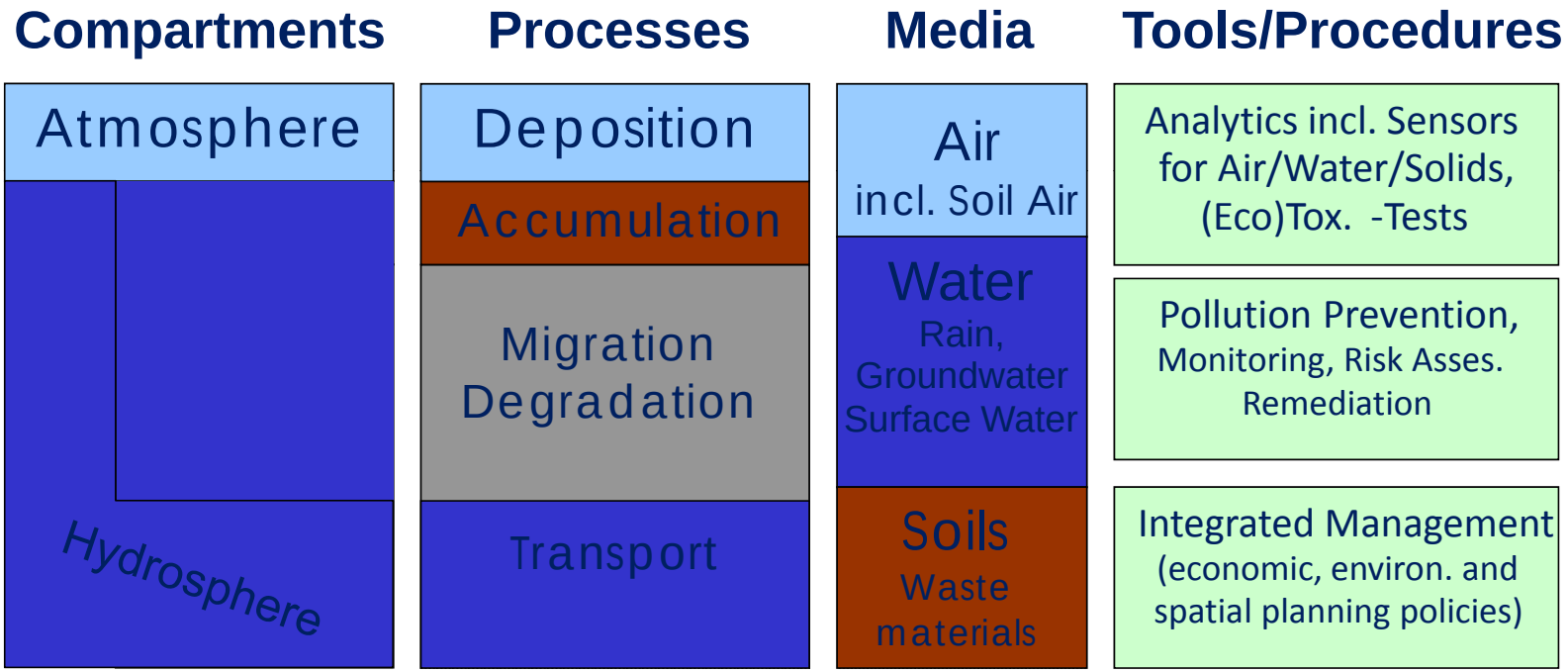
- Definition: Previously unknown or unrecognized (mystery) pollutants. (*Ignored Environmental Contaminants*)
- Detective work called *Environmental Forensics*
- " As any analytical chemist knows, what you see depends on what you look for " (Lynn Roberts, Johns Hopkins University)
- Emerging contaminants are generally not included in the legislation (*Non-priority Pollutants*)
- Emerging Contaminants= *Emerging Chemical Risks*
- *Emerging Issues and Short -Circuiting Risks*

Emerging Contaminants: Continuum of Risk

- Long-established widely recognized risks, as POPs or PBT(persistent bioaccumulative toxicants)
- Unexpectedly growing/developing risks (due to increasing consumption, as MTBE)
- Hidden, latent risks (previously unrecognized risk existing for some time, now recognized, as PPCPs)
- Future risks, currently not-existing risks (new generation of chemicals/drugs subjected to approval)

(Adapted from C.G. Daughton, US EPA, Las Vegas)

Inter-Compartment/Media Transport and Fate of Pollutants in the Water Cycle



Emerging Contaminants, US EPA

S. Richardson, 2001

Contaminant Candidate List (CCL) Analytes

- Pharmaceuticals
- Endocrine Disrupting Chemicals (EDCs)
- Polybrominated diphenyl ethers
- Algal toxins
- *Cryptosporidium* & *Giardia*
- Organotins
- MTBE (methyl-*tert*-butyl ether)
- DBPs (including NDMA)
- Perchlorate
- Arsenic

Emerging Contaminants (EU):
Water Framework Directive and the Precautionary Principle

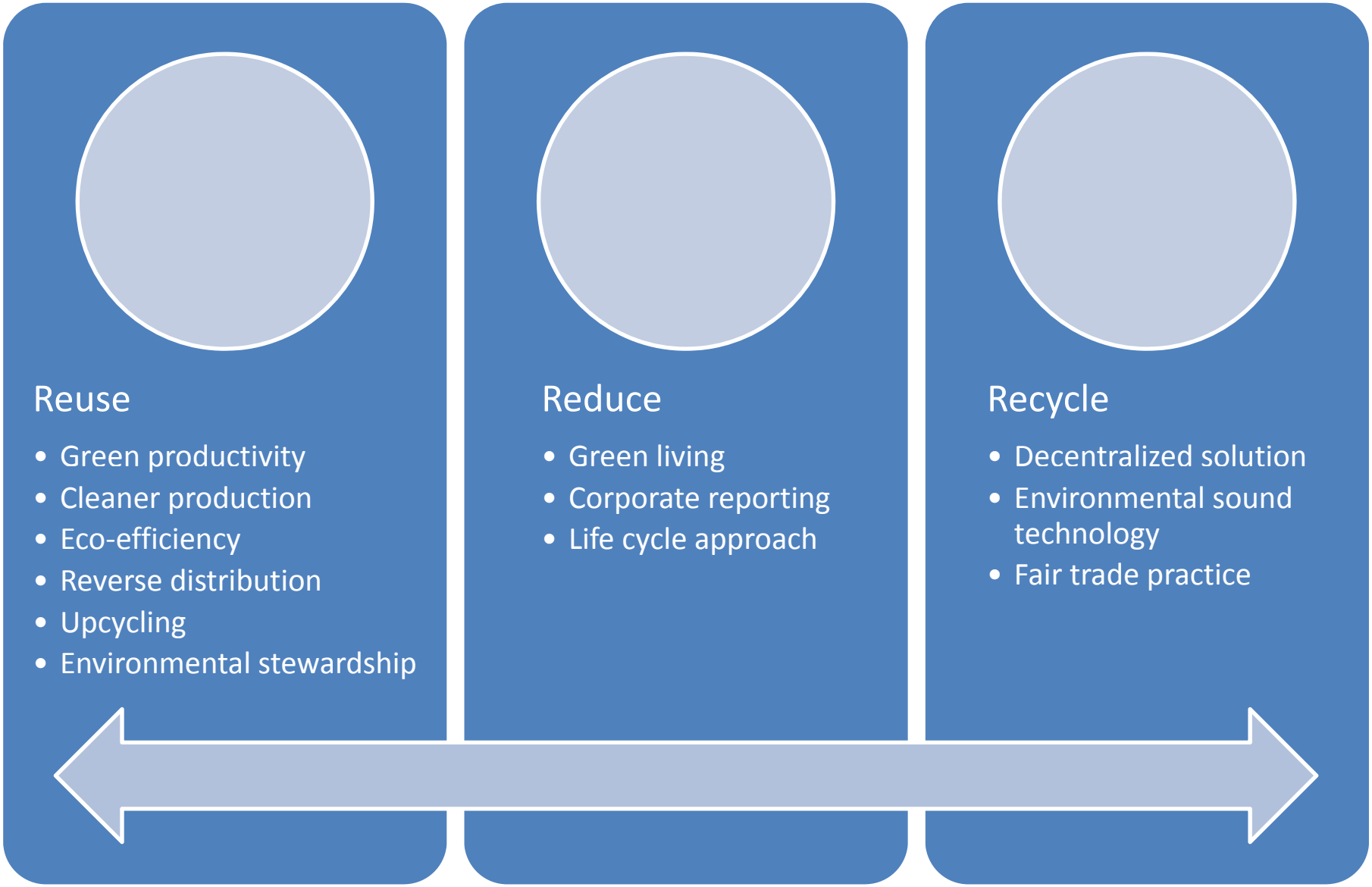
- Polybrominated Diphenyl Ethers (PBDEs)-
- Endocrine Disrupting Compounds-Alkylphenols-detergents, Phthalates
- Upcoming Priorities (Future Candidates for Monitoring) :
  - PPCPs (Pharmaceuticals and Personal Care Products) Diclofenac,Ibuprofen, EDCs
  - Veterinary pharmaceuticals for animal feeding
  - MTBE and related compounds

Pharmaceuticals

Considered as possible future CCL Drinking Water Contaminants (U.S. EPA):

- **Estrogen**
- **Diclofenac (antirheumatic)**
- **Carbamazepine (antiepileptic)**
- **Chloramphenicol (antibiotic)**
- **Concern about introduction of these compounds into drinking water**
- **Possible estrogenic effects**
- **Research at U.S. EPA and EU on fate & effect**

3R: Wider connotation: Top of pyramid approach



3R

- Will have positive ripple effect
- Promote local ecosystem with closed economy, with less dependence on external sources
- Waste recycling as prime strategy of sustainable waste management
- Establish waste-resource linkage
- Technology Vs policy maturity: Risk or opportunity (MEE/RO/ZLD)

Drivers of Change

Economic Instruments

- Environment al taxes
- Fees and user charges
- Certificate trading
- Environment al financing
- Green public procurement
- Subsidies

Regulatory instruments

- Norms and standards
- Environment al liability
- Environment al control and enforcement

Drivers of Change

Informational Instruments

- Eco-labelling
- Sustainability reporting
- Information Centres
- Consumer advice services
- Environmental quality targets and monitoring

Co-operational Instruments

- Technology transfer
- Voluntary agreements

Thanks