Guidance on Cost-Benefit Analysis

Supporting ALARP Decisions under COMAH Regulations

Structure of this presentation

1. Background information about the study
2. What can a CBA do to avoid Major Accidents to the Environment?
3. Approach to the study
4. Presentation of a potential framework to include CBA in future decision making
5. Illustrative case study
6. Findings from the study and next steps

Background to the study

- Aim of project: **To develop guidance to support Cost-Benefit Analysis (CBA) and support ALARP decisions whilst building on the Chemicals and Downstream Oil Industries Forum (CDOIF) Guideline on Environmental Risk Tolerability**
- Phased approach (see picture). **This is Phase 1:** a Study commissioned by Energy Institute end 2019 and conducted during 2020.

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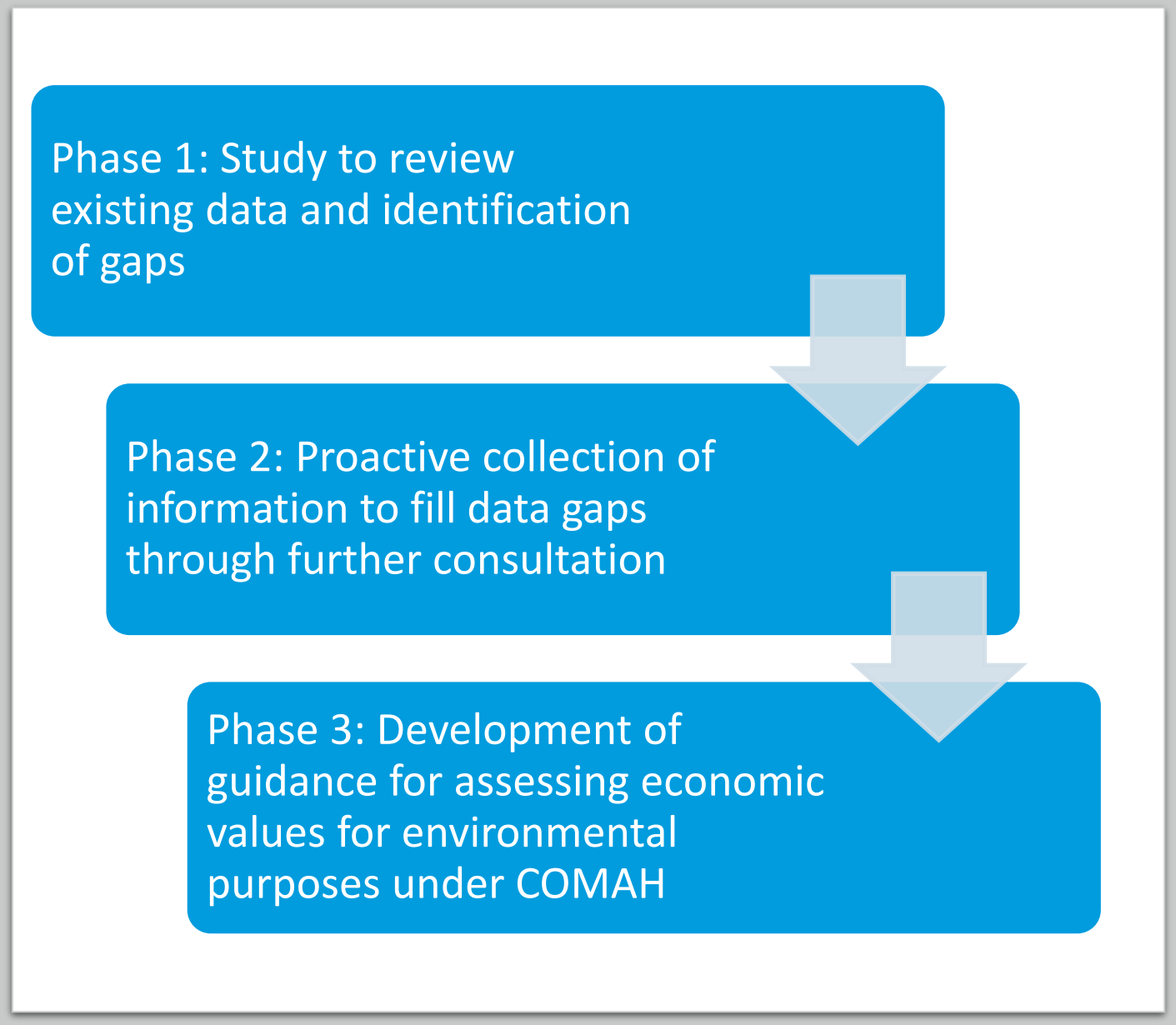

The Role of CBA in preventing MATTE

- **2015 CDOIF Guideline:**

  *An As Low as Reasonably Practicable (**ALARP) demonstration** may be required to further justify a claim of Tolerable if ALARP (or TifALARP) or Broadly Acceptable, this might include **Cost Benefit Analysis** ->* but little guidance on how to conduct a CBA

- **HSE:**

  CBA is a defined methodology for valuing costs and benefits […], giving a measure of transparency to the decision making process and […]

  can help a duty holder make judgements on whether further risk reduction measures are reasonably practicable

The Role of CBA in preventing MATTE

359 Upper Tier COMAH sites in the UK and 7,140 dangerous occurrences in 2014/15 to 2019/20 -> **very limited use of CBA. Can CBA be used to make better informed decisions and reduce the number of accidents?**

However,

- A CBA cannot be used to argue against the implementation of relevant good practice/argue against statutory duties
- A CBA on its own does not constitute an ALARP case/cannot justify risks that are intolerable
- The depth of analysis should be fit for purpose and a sensitivity analysis required if costs are disproportionate to benefits

Approach

Review of evidence on costs of Major Accident to the Environment (MATTE) to derive benefit estimates

Scope covers:

- Loss of containment (LoC) incidents (chemicals, petroleum products and by-products under national i.e. COMAH or international major hazard regulations); and
- Larger-scale events, with a threshold of overall cost of above £100,000 (in line with receptors of CDOIF Guideline).

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Example of databases on environmental incidents

eMARS (Major Accident Reporting System)
RAS Ltd environmental incident database, v3 Issue 2, provided by RAS Ltd
ARIA database
ZEMA database
FACTS chemical accident database
Finnish Safety and Chemicals Agency (TUKES) database
US Chemical Safety Board

Review of accident data – Main findings

- No monetary estimate of the damages in most cases
- Significant variation in costs not matched to severity (e.g. Buncefield cat. 2 but £30-£50m in damages)
- Not always clear what is included in the damages (most frequently clean-up costs and remediation costs)
- Limited description of environmental impacts, impact duration or effect of mitigation measures

-> **actual data on costs is of limited use to estimate the benefits from avoiding MATTE**

Review of accident data – Main findings

However, agreement on factors affecting the level of costs:

- Type of substance: toxicity
- Type of costs: compensation costs can be linked to level of damages, although not always
- Type of receptor: rare species higher costs
- Duration and recovery aspects: deriving the tolerability for MATTE (applying the Tolerability Assessment Matrix to determine tolerability boundaries).

Current challenges to estimate benefits from avoiding MATTE

1. Definition of environmental baseline

- Which receptors?
- Which services?

2. Definition of impact

- Which impact?
- Which scale/value?

Potential framework for estimating benefits from preventing MATTE

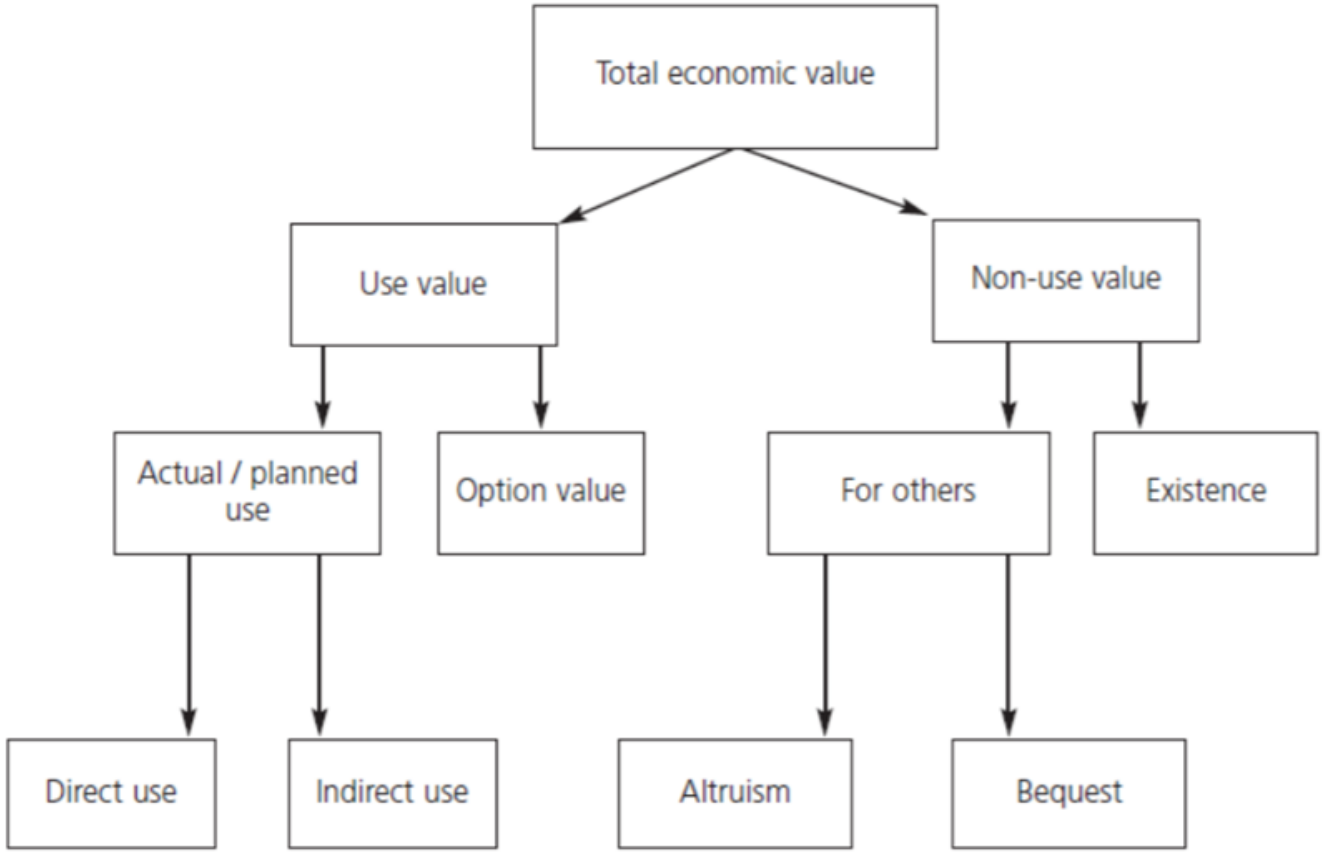
Based on 2 main approaches:

1. Ecosystem services approach (nature provide services)
2. Natural Capital approach (nature as a asset)

Both aims to capture the **Total Economic Value (use and non-use value).**

2 methods:

1. Market-based: visitors' income, travel costs expenditure, impacts on crops
2. Non-market based: willingness to pay surveys



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Impacts from accidents on the environment – Examples of costs (benefits from avoiding MATTE)

Recreational and commercial fisheries:

- Loss of stock
- Loss of recreational fishing (including fishing licences or membership fees)

Tourism and Other Recreational Activities:

- Temporary closure to nearby sites of interest
- Loss of income to local business

Other amenity costs associated with spills are listed below:

- House prices
- Damage to local property
- Opportunity cost of investment into other ventures being missed out on because funds spent on clean-up costs

Carbon sequestration: will depend on the type of habitat affects, with variations between land and marine habitats being reported. Also UK government values available for shadow price of carbon.

Framework for estimating benefits from preventing MATTE

1. Identify receptors (from ERA/CDOIF Guideline)
2. Identify the potential impacts (following ERA processes)
3. Identify ecosystem services affected by impacts and linked to receptor
4. Quantify the impacts/monetise (benefits as avoided costs)

Include benefits:

- Averted impact on the value of ecosystem services;
- Clean-up costs for similar accidents and environmental baseline (from previous accident data if available); and
- Opportunity cost of investment into other ventures being missed out on because funds spent on clean-up costs.
- Exclude fines and legal fees

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Key factors affecting benefits

Severity	Recovery
• Type of chemical being considered (substance) • Quantity of chemical released • Nature of release • Pathways of environmental exposure accounting for chemical fate and transport • Type of receptor (habitat or species and its status) • Effect of the release in terms of area or population impacts (scale) • Whether the receptor is land or water-based (turnover rates tend to be shorter in aquatic systems than terrestrial systems) • Season/time of the year	• Type of chemical and its environmental fate, behaviour and/or potential effects in the environment, covering the 60 chemicals listed in the COMAH regulations • Type of habitat or species • Whether the receptor is land or water-based
Source: extracted from CDOIF Guideline	

Environmental benefits transfer value from avoiding MATTE and potential values for severity

Receptor (CDOIF)			Value	Unit	Note on value
Designated Land/Water Sites (Nationally important)	Land or Surface Water	NNR, SSSI, MNR	£201,707	TEV of average SSSI site	Based on the value of total benefits provided by SSSI in England, divided by number of SSSI sites
Designated Land/Water Sites (Internationally important)	Land or Surface Water	SAC, SPA, RAMSAR	£23,825,494	TEV of average RAMSAR site	Based on the TEV of wetlands based on 200 case studies. Does not include medicinal, historic and spiritual values, sediment control so likely an underestimate
Other designated Land	Land	ESA, AONB, National Park, etc.	£639.09	Per ha/year	Based on TEV of an AONB per ha per year
Scarce Habitat	Land or Surface Water	BAP habitats, geological features	£5.91	Per ha/year	Based on the average value of 19 BAP habitats
Widespread habitat (non designated land)	Land	Land/water used for agriculture, forestry, fishing or aquaculture	£49	Per ha/year	Likely underestimate. Based on loss of crop productivity due to soil compaction.
Groundwater Source of Public or Private Drinking Water	Groundwater or surface water drinking water source (public or private)	Drinking water sources (SPZs in England and Wales) - See 3.2.3 for further guidance.	£0.0033	Per person/hour	Based on the 3 values including water abstraction and treatment, long run marginal costs for water companies, and average water replacement costs
Groundwater Non Drinking Water Source	Groundwater (other)	Aquifers (non-drinking water sources)	£3,536	Per ha/year	TEV of groundwater for the following habitats: Inland Marsh, peat bog, saltmarsh, intertidal. Adjusted by removing valu of drinking water
Soil or Sediment	Land		£19.90	Per ha/year	Highly uncertainly. Maintaining soil fertility, reflects lack of data
Built Environment	Built Environment	This is limited to Grade 1 / Cat A Listed buildings, scheduled ancient monuments, conservation area, etc.			Value range too wide to provide an estimate / lack of data
Particular Species	Land				Values highly dependant on species
Marine	Surface Water		£19,604	Per ha/year	TEV of marine environment (comprising open ocean and coastal systems)
Fresh and estuarine water habitats	Surface Water		£20,200	per km/year	Assumed value of status lowered by 1 equal value of status raised by 1. Value taken from HM Treasury Green Book

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Illustrative case study

Scenario A -> estimated benefit of avoiding the accident is £486k.

Oil spill occurs at site A. Three credible receptors:

- Groundwater (non-drinking water);
- Groundwater (drinking water); and
- Some nearby widespread habitat (non-designated land).

ERA:

- Impacts on groundwater (non-drinking water) as MATTE A;
- Impacts on groundwater (drinking water) and widespread land habitat were assessed as Sub-MATTE.

Scenario B -> the estimated benefit of avoiding the accident (Scenario B) is £3.75 million

Also an oil spill at same site. 5 credible receptors:

- Groundwater (non-drinking water);
- Groundwater (drinking water);
- Nearby widespread habitat (non-designated land);
- River A; and
- Designated land (SSSI).

ERA:

- Designated Land/Water Site (Nationally important; SSSI): MATTE A;
- Fresh and Estuarine Water Habitats: MATTE A;
- Widespread Habitat (Land): MATTE A;
- Groundwater (non-drinking water): MATTE B; and
- Groundwater (drinking-water): MATTE B.

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Illustrative case study – Main findings

- Significant variation depending on the inclusion of receptors -> environmental services and costs avoided
- CDOIF thresholds and outputs not detailed enough to provide benefit estimates
- But data from the ERA process could be of use when calculating the benefits and significantly improve the reliability and effectiveness of any CBA that needs doing under the process).

Findings from the study

1. There is a need to embed the ecosystem services provided by nature in the estimation of benefits from avoiding MATTE and the ERA process
2. More data are needed in order to populate and estimate the benefits (past incident data can help but primary data gathering needed)
3. Clean-up costs, although frequently reported, are an underestimate of the benefits
4. Benefits can vary significantly depending on factors such the environmental baseline and type of receptor in addition to aspects such at the substance

Next steps: addressing main data gaps in Phase 2

More detailed information on accidents:

1. More detailed information on clean-up costs
2. More detailed information on receptors affected
3. Further information on environmental consequences of accidents
4. Further investigation into values for environmental damages (although study includes some ref. to existing government sources these need tailoring for CDOIF specific guidance on CBA).

Thank you - Q&A

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