SuRF Launch Meeting - May 13th 2008

Sustainability Appraisal Tools

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Outline

- Background
- How is sustainability assessed
  - Indicators
  - Tools and techniques
- A tiered approach
- Conclusions

- Additional information (will be on the web)
  - Example techniques in more detail: cost benefit analysis; carbon footprint; life cycle assessment
  - Their strengths and their weaknesses

Background
- the elements of “sustainability”

- Compliance with the principles of sustainable development is the most consistent and overarching meaning
  - 1987 Brundtland report *Our Common Future*: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”
- 3 “pillars”: *People*, *Planet* and *Profit* =
- 3 elements: social, environmental and economic

UK Policy Maps to 3 Elements

- Defra 2005:
  - Living within environmental limits (environment)
  - Achieving a sustainable economy (economy)
  - Ensuring a strong, healthy and just society (society)
  - Promoting good governance (society)
  - Using sound science responsibly (society)

Also important:

- Considering economic, environmental and social elements in an integrated way
- Considering long term effects as well as short term effects
- Assessing indirect as well as direct effects
- Taking particular care when changes would be irreversible
- Involving stakeholders

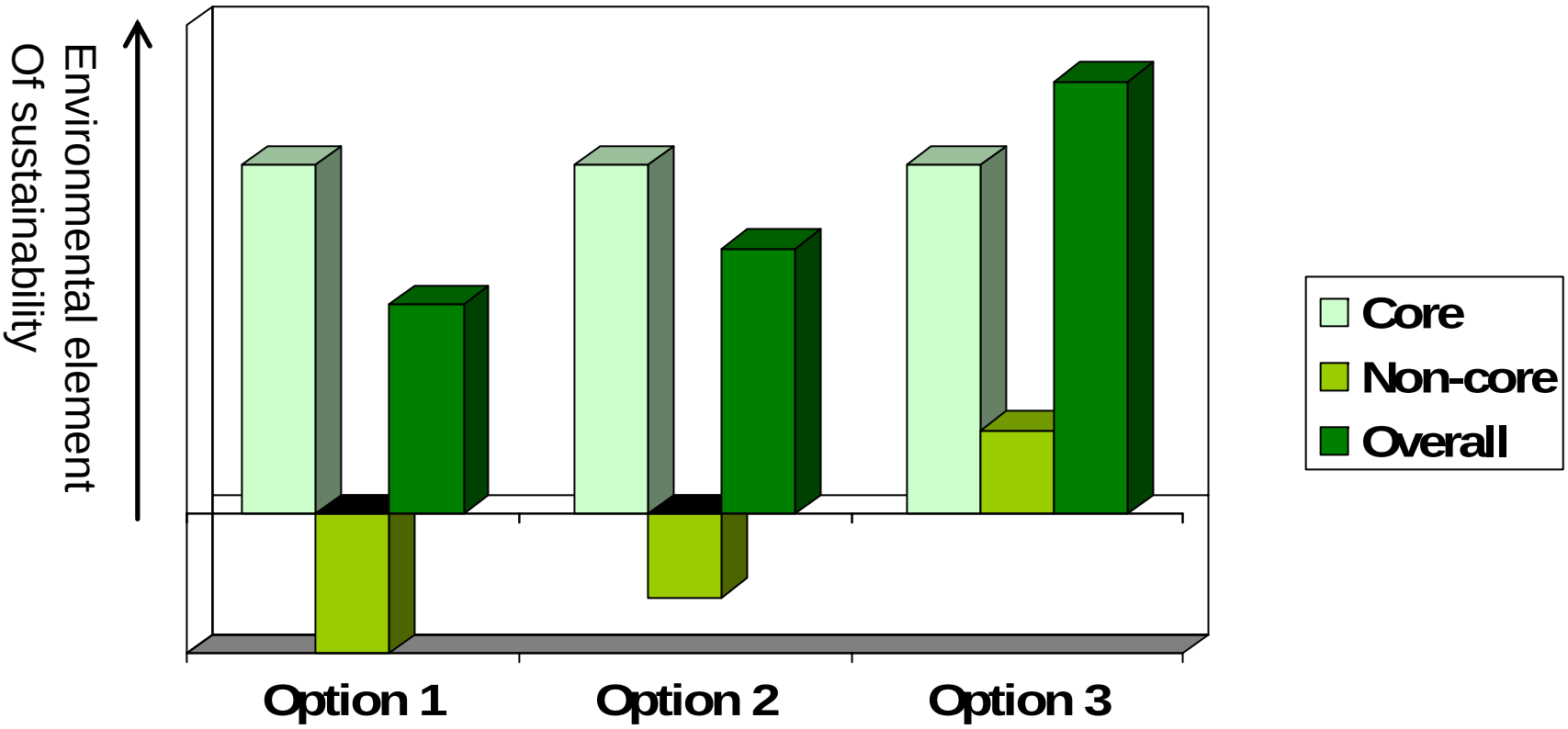
Promoting good governance

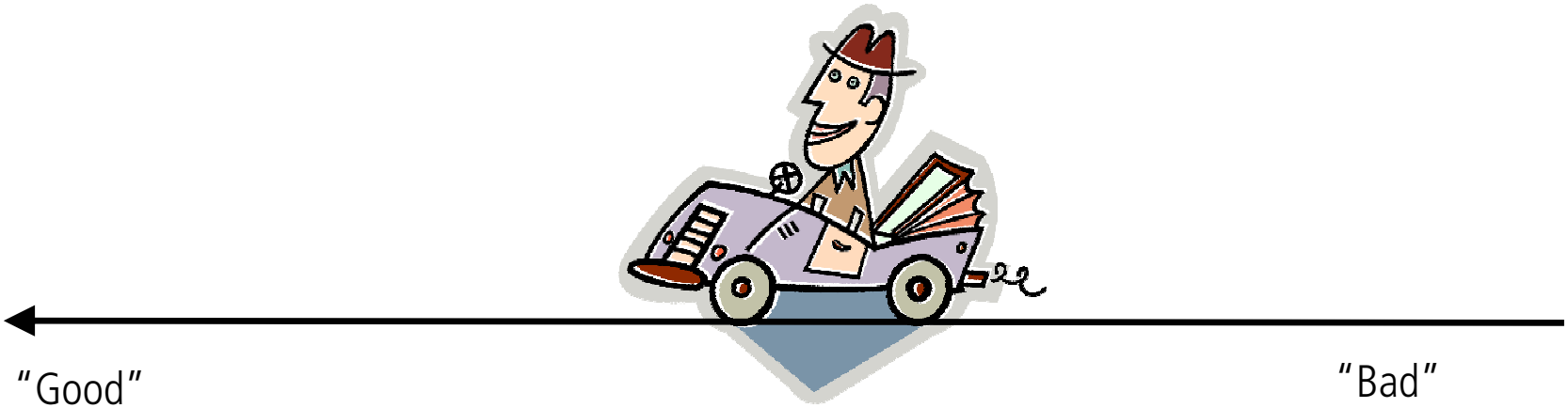
"Excellent! So that's passed then. All we need do now is draft the consultation document"

Sustainability Appraisal in Contaminated Land Management

- The Model Procedures (CLR 11) suggest that wider considerations play a role in the evaluation of remediation options
- Supporting procedures
  - Cost benefit
  - Wider environmental value (sustainable remediation)
- This includes an explicit assumption:
  - That the goals of the project (the drivers for remediation) are fixed, in particular the risk management goals
  - These risk management goals have a contribution to “sustainability”
  - Different remediation approaches can enhance or detract from this “core” sustainability

“Core” and “Non-core” sustainability



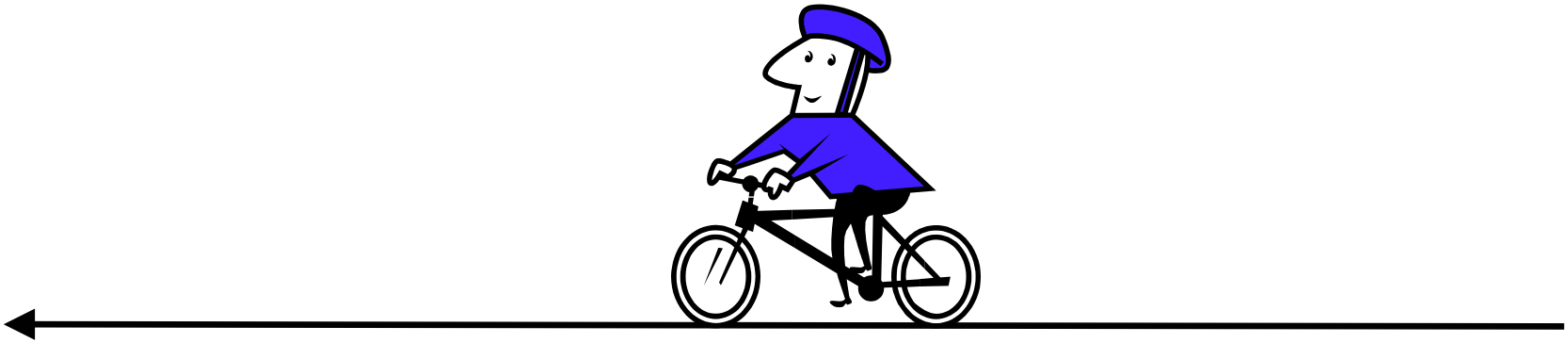


"Good" environment

"Bad" environment

Once upon a time the journey was enough

Now we have to take a sustainable route as well



"Good" environment

"Bad" environment

How is sustainability assessed

- Typically on the basis of evaluating “indicators”
  - Measurements that are considered representative of sustainable development (quantification)
  - Evaluations (qualitative)
    - against some kind of benchmark such as a policy goal
    - considering upward / downward trends
    - comparing options

UK Sustainable Development Policy: Framework Indicators

- **1. Greenhouse gas emissions:** Kyoto target and CO2 emissions
- **2. Resource use:** Domestic Material Consumption and GDP
- **3. Waste:** arisings by (a) sector (b) method of disposal
- **4. Bird populations:** bird population indices (a) farmland birds (b) woodland birds (c) birds of coasts and estuaries
- **5. Fish stocks**: fish stocks around the UK within sustainable limits
- **6. Ecological impacts of air pollution:** area of UK habitat sensitive to acidification and eutrophication with critical load exceedances
- **7. River quality:** rivers of good (a) biological (b) chemical quality
- **8. Economic output:** Gross Domestic Product
- **9. Active community participation:** civic participation, informal and formal volunteering at least once a month
- **10. Crime:** crime survey and recorded crime for (a) vehicles (b) domestic burglary (c) violence
- **11. Employment:** people of working age in employment
- **12. Workless households:** population living in workless households (a) children (b) working age
- **13. Childhood poverty:** children in relative low-income households (a) before housing costs (b) after housing costs
- **14. Pensioner poverty:** pensioners in relative low-income households (a) before housing costs (b) after housing costs
- **15. Education:** 19 year olds with level 2 qualifications and above
- **16. Health inequality:** (a) infant mortality (by socio-economic group) (b) life expectancy (by area) for men and women
- **17. Mobility:** (a) number of trips per person by mode (b) distance travelled per person per year by broad trip purpose
- **18. Social justice:** (*social measures to be developed)*
- **19. Environmental equality:** *(environmental measures to be developed)*
- **20. Well being:** *(well being measures to be developed if supported by the evidence)*

Specific policy area indicator sets (examples)

- Strategic planning for sustainable waste management (2006)
- Indicators of sustainable development for Scotland (2005)
- Indicators for sustainable development for Wales (2006)
- Environmental performance indicators: reporting guidelines for UK business (2005)
- Environment in your pocket 2007 – almost 60 indicators
- Sustainable farming and food strategy indicators (2002+)
- Sustainability appraisal of regional spatial strategies (2005)
- Local development framework core output indicators (2005)

Other indicator sets (examples)

- Sustainability indicator sets may also be used for:
- EU level policy evaluation
  - 2007 monitoring report of the EU sustainable development strategy
- Sustainable business purposes
  - Global Resources Initiative: economic, society and economic indicator protocols sets (2006)
- Setting campaigning agendas
  - Forum for the Future: The Sustainable Cities Index (2007)

Indicators in overview

- Indicator sets are widely used for strategic sustainability appraisal purposes
- Often orientated to policy / political / corporate goals
- Many sets, often different considerations
- Indicators can be somewhat esoteric for the average remediation project (e.g. “pensioner poverty”)
- Very difficult to “visualise” sustainability overall from this wide range of indicators

Indicator Sets: Contaminated Land Orientated

- Assessing the Wider Environmental Value of Remediating Land Contamination: A Review. R&D Technical Report P238; r^3, LQM, TNO (2000) - http://www.eugris.info/displayresource.asp?ResourceID=3869&Cat=document
  - Qualitative assessment, based on rankings and consensus building
  - Aggregated indicators under “headlines”: aggravation factors, air and atmosphere, water environment, ground function, legacy, resource / energy use and conservation
  - Only covered the environmental “element”
- SU:BRIM Redevelopment Assessment Framework suggests site specific sustainability indicators (SUB4 2007) – www.claire.co.uk

Tools and techniques that might be used for sustainability appraisal

- While sustainability appraisal is widely used for policy evaluation, it is less common for evaluating environmental technology decisions
- There are a range of tools / techniques that might be used to reduce complexity and facilitate decision making
- There is no “standard” approach

Tools / techniques in overview (1)

	Env	Ec	So	Type	CLM
Best Practical Environmental Option (BPEO) / Best Available Technique (BAT)	Wide	Narrow		Qual	✓
Carbon footprint ("area")	Narrow			Quan	✓
Carbon balance (flows)	Narrow			Quan	
Cost benefit analysis	?Wide	?Wide	?Wide	Quan	✓
Cost effectiveness analysis	?Wide	?Wide	?Wide	Qual	✓
Eco-efficiency	Narrow	?Narrow		Quan	?
Ecological footprint	Narrow			Quan	
EMAS / EMS ?	?Wide			Qual	
Energy / intensity efficiency	Narrow			Quan	✓

Tools / techniques in overview (2)

	Env	Ec	So	Type	CLM
Environmental risk assessment	?Narrow			Quan	✓
Environmental impact assessment / Strategic environmental assessment	?Wide			Qual	✓
Financial risk assessment		Narrow		Quan	✓
Industrial ecology	?Wide	?Wide		Quan	
Lay participation	??	??	Wide	Qual	?
Life cycle assessment (based)	"Narrow"			Quan	✓
Public Benefit Recording System	?Wide	?Wide	?Wide	Quan	✓
Quality of life assessment	Wide	Wide	Wide	Qual	
Scoring / ranking systems (may include MCA / MAT)	Wide	Wide	Wide	Qual	✓
Sustainability threshold analysis	Wide	Wide	Wide	Qual	

Tools / techniques in overview

- The table contains a variety of tools and techniques for evidence collection, evaluation and decision making
  - Most available tools or techniques evaluate a *component* of sustainability
  - Quantitative techniques tend to be *narrower* in scope
  - “Sustainability appraisal” may form part of other assessments – e.g. UK guidance for the S.E.A. Directive

Boundaries, Scope, Objectives

- A common purpose is essential for any assessment to be valid in discussions between different stakeholders = an agreed objective and scope
- The scope is set by boundaries:
  - life cycle consider how far the option being considered should be broken down into sub-units requiring some sort of analysis
    - *impacts from cradle to grave – every nut and bolt?*
  - system: the "edges" of the system being considered
    - *set as the remediation needed to reach the “core objectives”?*
  - geographical boundaries
    - *are local effects of particular importance?*
  - time
    - *are temporary effects more tolerable?*
- Findings for all tools and techniques may be determined in large part by the selection of these boundaries

Qualitative vs Quantitative

- Qualitative
  - Broad in scope (many indicators)
  - Transparent route from evidence through evaluation
  - Not easy to visualise
  - “Soft information”
- Quantitative
  - Tends to be narrower in scope (fewer indicators)
  - Simpler to visualise
  - Less transparent
  - *Perceived* as “hard” information

A Tiered Approach

- A tiered approach has significant merit. It is flexible and provides options to assess sites to the degree necessary.
  - Tier 1: Qualitative accessible approach (broad scope, rapid and low cost)
  - Tier 2: Consensus / consultation to elaborate qualitative assessment
  - Tier 3: Semi-quantitative (more detail therefore more effort and cost)
  - Tier 4: Quantitative most complex

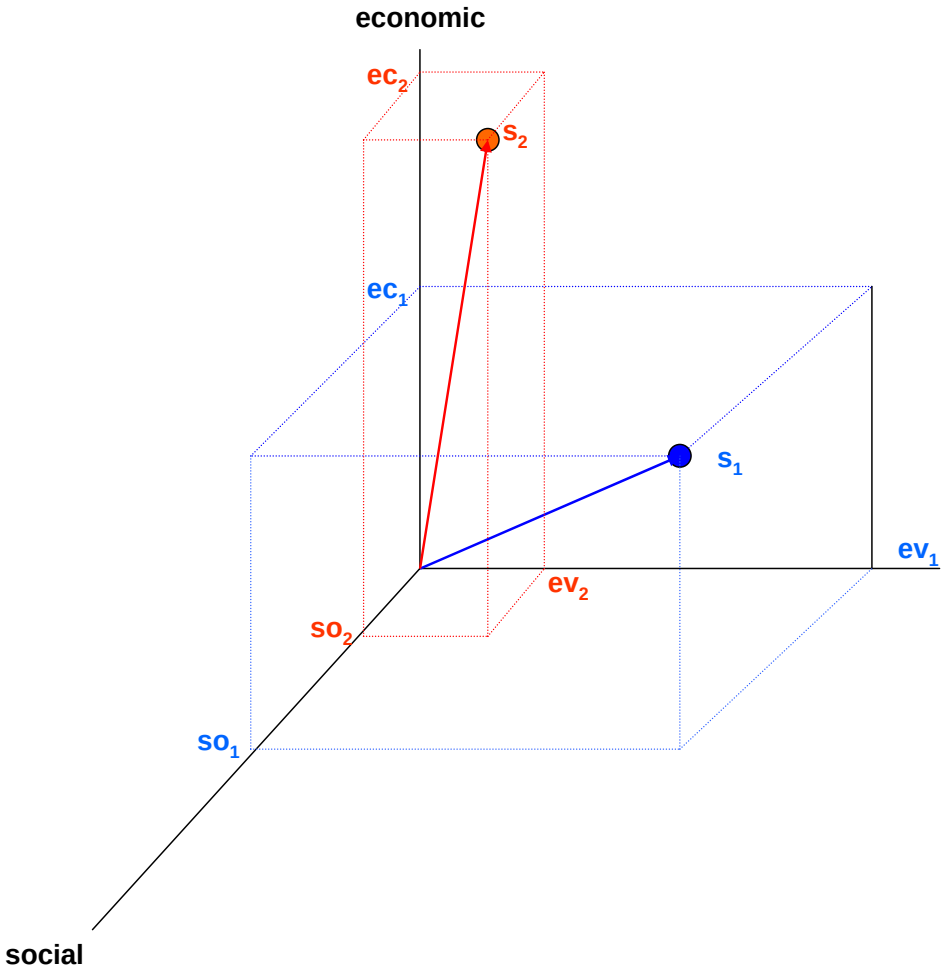
- Aim: to make sure decision investment is well targeted , e.g.
  - Decide if a consultative / consensus based approach is warranted
  - Reserve quantitative approaches for decisions that remain deadlocked
  - Use the qualitative / consensus stages to “target” more expensive quantitative assessments

- A stepwise approach supports a sustainable use of resources for the sustainability appraisal process *itself*

Tiers 1 / 2: Qualitative Stage Suggestion

- Ideally the qualitative stage would:
  - Provide a visualisation of complex individual indicators (evidence) of sustainability
  - Be auditable back to its original evidence base
  - Be transparent to interested parties with widely varying backgrounds and expertise
- Following is one suggestion
  - Under development by r^3, based on work done for P238 and subsequently with LQM and University of Nottingham

A visualisation of sustainability



Which option is better?

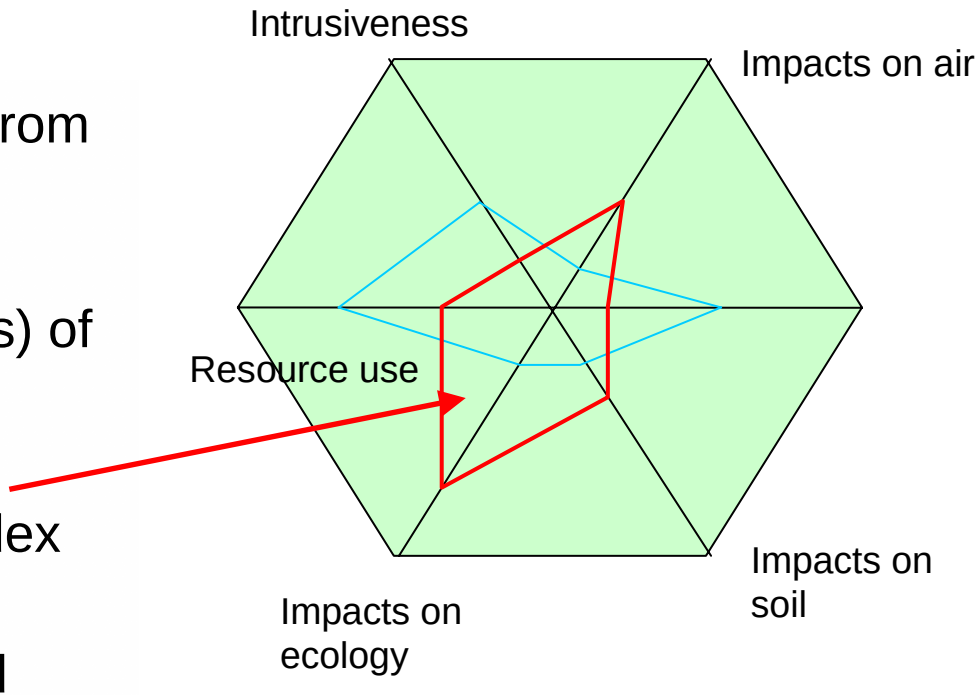
What are the key influences / choices?

What might be in each element?

Environmental	Economic	Social
Impacts on air Impacts on water Impacts on soil Impacts on ecology Intrusiveness Resource use	Direct costs Indirect costs Gearing Employment Local effects Life-span / flexibility	Community involvement Community satisfaction Ethical considerations Aggravation / local impacts Fit with local and national planning and policy strategies Uncertainty and evidence

Environmental element in more detail

- The “element” is integrated from “headline” indicators
- These can be visualised on “radar” plots (Kiviat diagrams) of “headline indicators”
- The *area* is used as the integrated environmental index for the 3-D plot
- Each headline is aggregated from individual indicators supported by a “table of evidence”

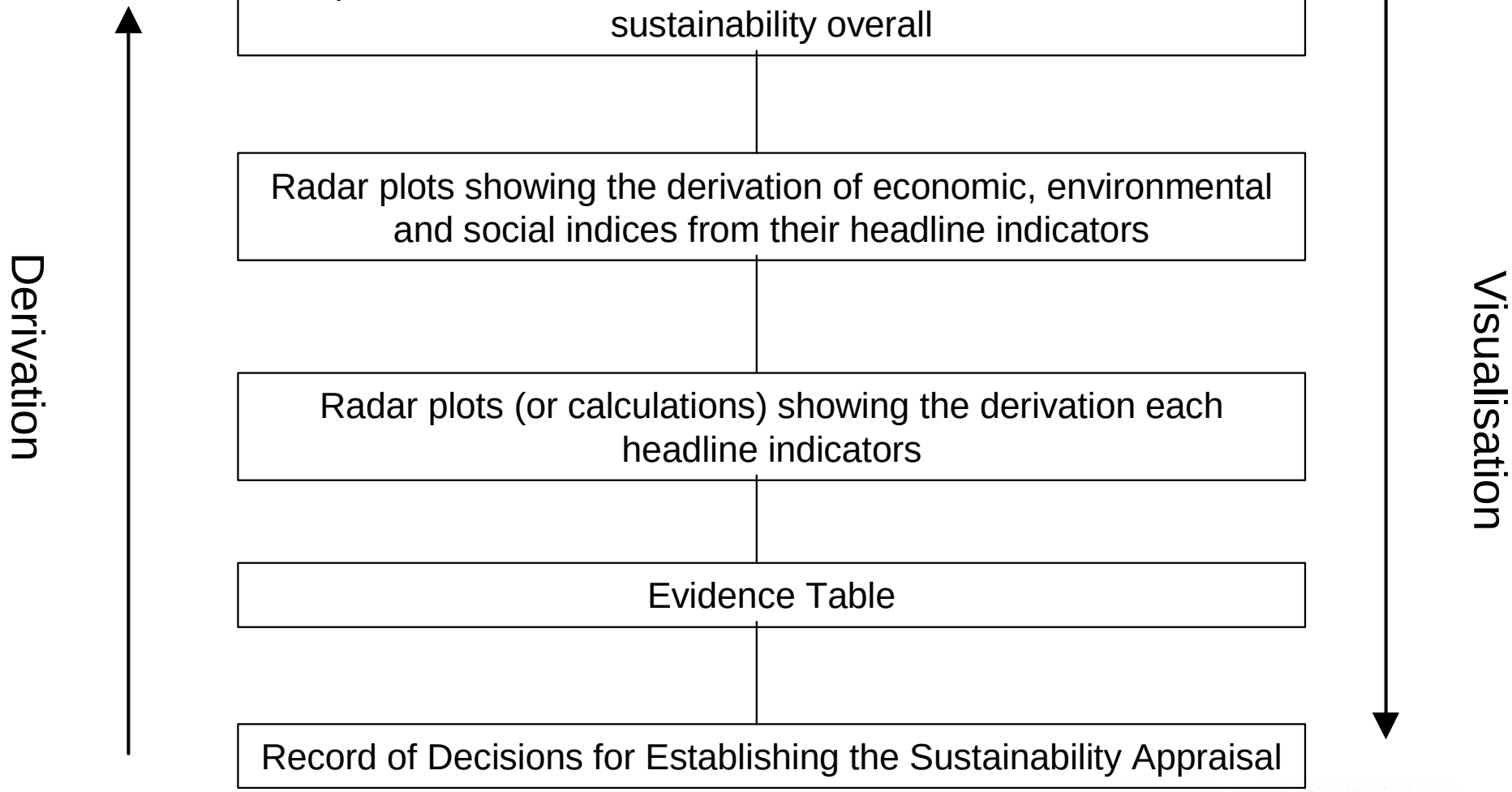


environmental technology

An example from waste management

Indicator		Ideal	Option 1	Option 2	Option 3	Evidence
Headline: Impacts to Air	Emissions contributing to acidification to air	Zero emissions	2	1	3	*Ranking based on emissions of NOx, SOx reported in: Environmental Impact Assessments for each project option*
	Emissions of dust and particles (including bioaerosols and PM_{10}) to air	Zero emissions	2	1	2	*Ranking based on:* *(1) Emissions of airborne dust and PM_{10} reported in: Environmental Impact Assessments for each project option* *(2) Annex 1[1] to evidence table: qualitative bioaerosol risk assessment for options 1, 2 and 3*
	Emissions of greenhouse gases to air	Zero emissions	2	2	1	*Ranking based on WRATE[2] modelling, see Annex 2 to evidence table*
	Emissions of ozone depleting substances to air	Zero emissions	1	1	1	*The main source of ozone depletion will be in household products, particularly reporting to the "metals" fraction, which will be handled similarly in all options (i.e. separated and crushed)* ***Problem issue?***
	Etc					

sustainability appraisal process components



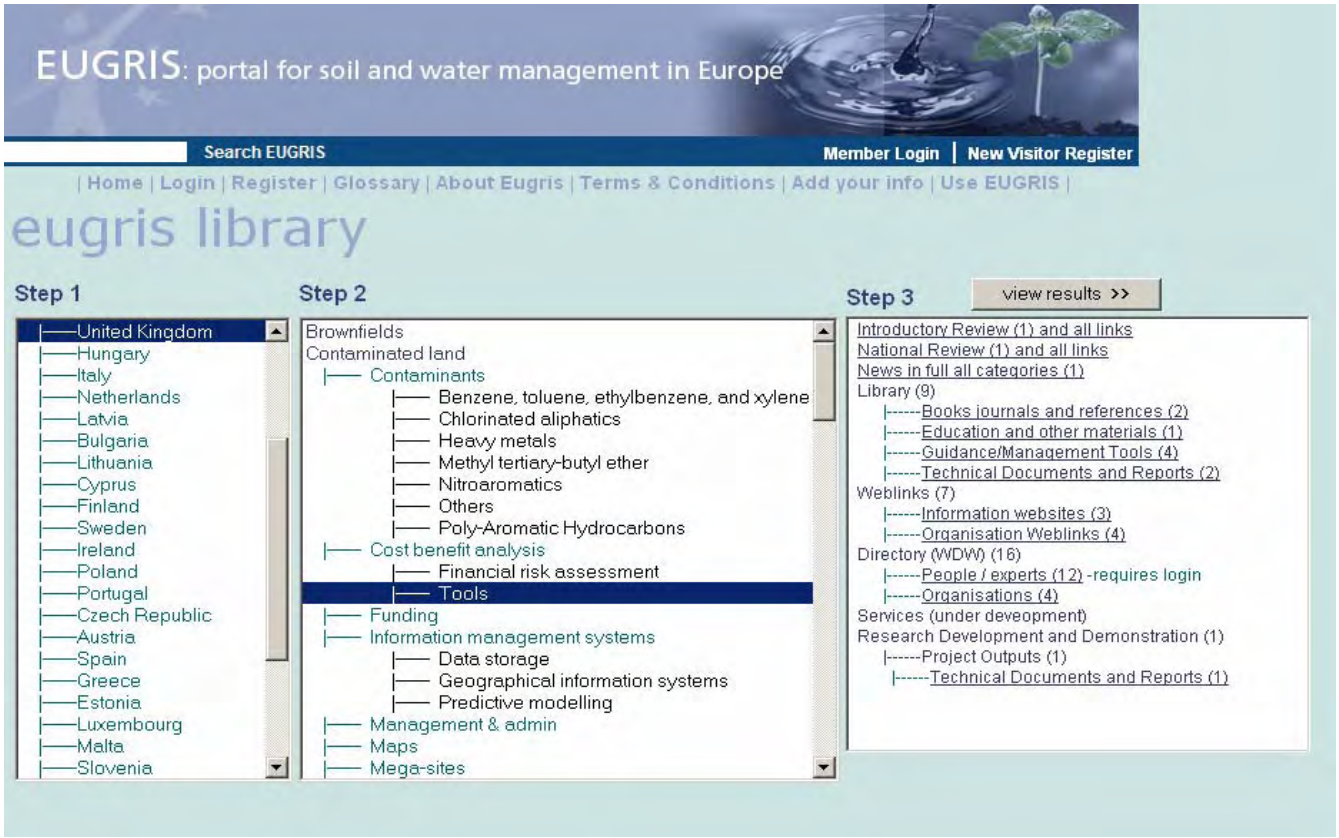
Some concluding thoughts

- None of these techniques is an absolute valuation
- All are fundamentally flawed in that they can only assess what we know or perceive may be an issue
  - E.g. would a contemporary appraisal of DDT have taken into account impacts on birds of prey?
  - E.g. the current biofuels debate – what appraisal of even known effects ever took place before the initial scope of policy / research was set?
- A tiered approach may be best. It is flexible and provides options to assess sites to the degree necessary.
- Be VERY careful about agreeing objectives, indicators, scope and boundaries – these determine findings

Thank you

- If you want to find out more:
  - paul@r3environmental.co.uk

Can review and check out many tools on EUGRIS: www.eugris.info



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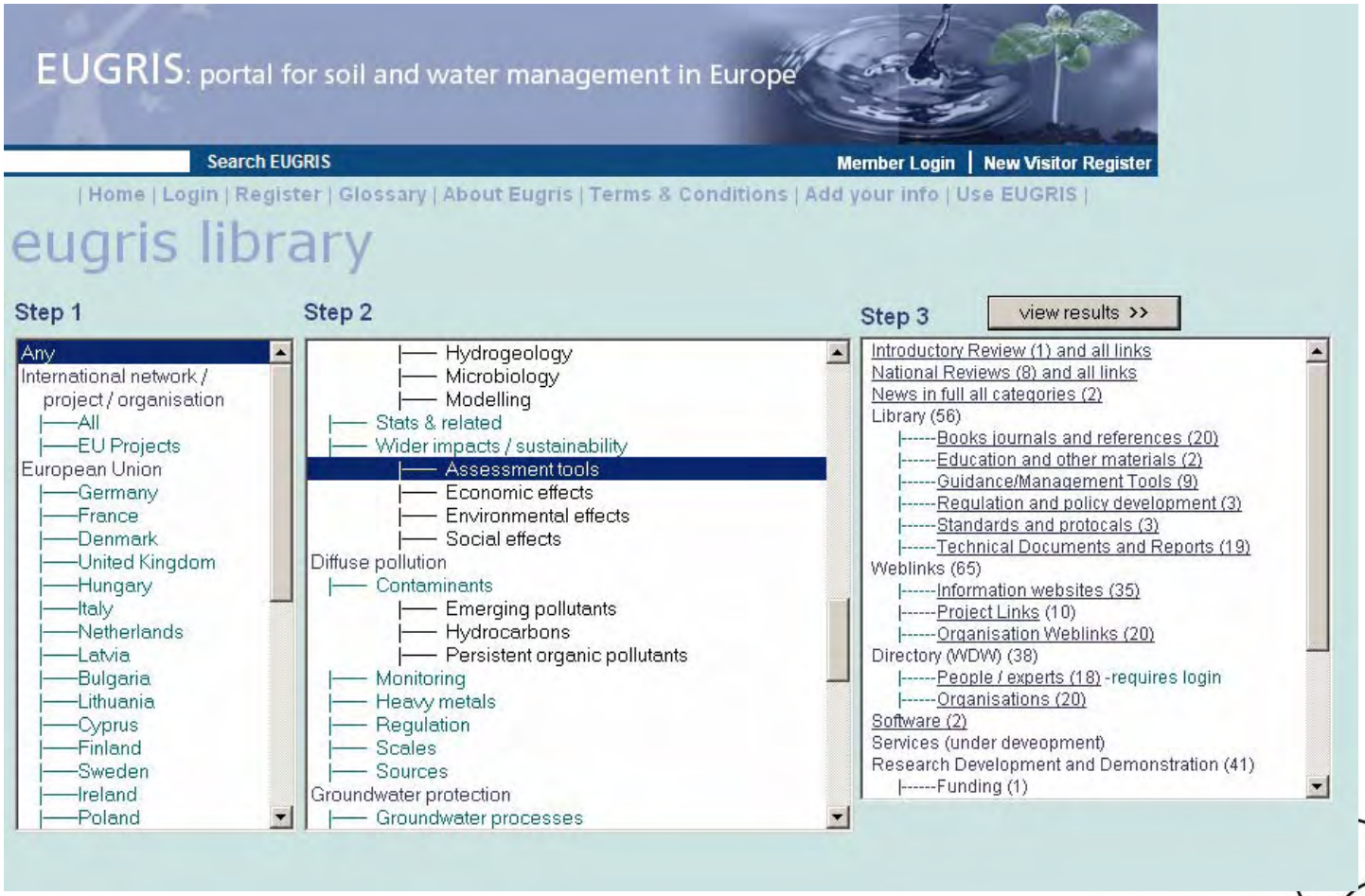


Additional Information

Cost Benefit Analysis

- A form of economic analysis in which costs and benefits are converted into monetary values for comparison
  - Private or internal factors: impacts and benefits that already have a direct relationship to the project
  - Public or external factors: impacts and benefits that have a more subjective relationship with the project: e.g. the value of each human life saved as a result of a remedial action
- Valuation
  - may be direct, especially for private factors (e.g. cost of the remediation application, the expected change in value of the site etc)
  - may require a judgement based valuation technique (e.g. value of a protected habitat), typically applied to external factors

CBA valuation techniques (1)

- Contingent Valuation Method (CV)
  - Based on assessments of consumers willingness to pay (WTP) for something; or their willingness to accept (WTA) compensation for it
  - Assed by surveys of “consumers” (typically using a hypothetical scenario) are asked to assign monetary values to both WTP and WTA
- Hedonic Pricing Method (HP)
  - Based on relationships between the levels of environmental services (e.g. noise levels) and the price of marketed goods (e.g. houses)
  - Cannot be used to estimate the subjective factors that cannot be seen as directly affecting marketed goods

CBA valuation techniques (2)

- Production Function Methods
  - Similar to HP by inferring value from marketed goods and services, two broad approaches:
    - avoided cost (AC): evaluation of environmental quality through quantification of averting expenditure (i.e. how much are people willing to pay to avoid or protect them from a decrease in environmental quality?)
    - the dose-response (DR) method, the physical effects of contamination on the environment are evaluated and used within an economic model. Two phases:
      - the derivation of the contaminant response dose and receptor response; and
      - the choice and application of an economic model
- These are all “derived” by experts based on surveys and inferences so they lack transparency, and the evidence base may not be appropriate

CBA strengths and weaknesses

- Strengths
  - Can be a very powerful and flexible “visualisation” that reads across many backgrounds and interests
  - Logical fit to corporate decision making
  - Lends itself to modelling
  - Quantified findings *perhaps*
  - Very technical approach
- Weaknesses
  - The finding is highly dependent on “breadth of approach” – no checklist?
  - Valuation procedures for public costs
  - May not be seen as inclusive / may not be acceptable to all stakeholders
  - Link to evidence may be tenuous e.g. where “standard values” are used

Life Cycle Assessment Based Tools (1)

- Evaluate the environmental consequences of products or services and their use from cradle-to-grave
- *Cradle-to-grave approach*: all processes connected with the function, from the extraction of resources until the final disposal of waste
- Said to be comprehensive with respect to the environmental interventions and environmental issues considered
  - However LCA is subject to a number of simplifying assumptions in order to make the analysis practically achievable which introduce subjectivity

Life Cycle Assessment Based Tools (2)

- LCA may provide *quantitative* or *qualitative* results
  - Quantitative based on models or measurements of individual impacts: e.g. acid gas emissions, these are then converted to dimensionless numbers (e.g. kg, J are dimensions), normalised (e.g. set to the same range such as 0 to 1) and then aggregated

- Two strategies have been used in CLM decision making: simplified project specific valuation; aggregation of impacts of standardised unit processes / activities

REC Model / ROSA

Positive aspects	Unit
clean soil as a result of remediation	m^3
Clean groundwater as a result of remediation	m^3
Prevention of groundwater contamination	m^3
Negative aspects	
Loss of soil Loss of groundwater Energy consumption Air emissions Emissions into surface water Final waste Space use	m^3 m^3 x 1000 G^3 * * m^3 m^2

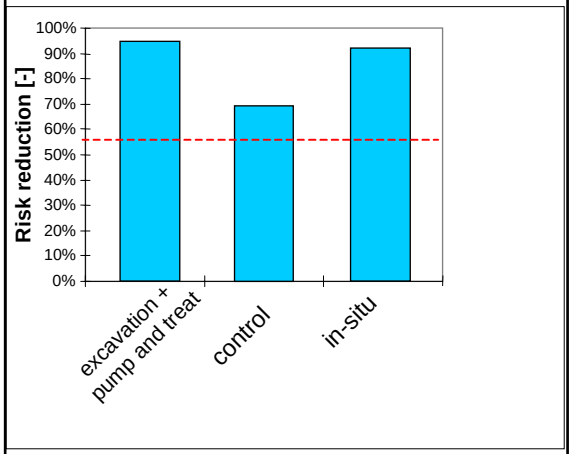
- Developed in the Netherlands in 1990s, applied to perhaps 100 project assessments to date
- Combines elements of LCA and CBA
- Compares three indices: costs (private), risk reduction and "environmental merit"
- Environmental merit is based on LCA techniques

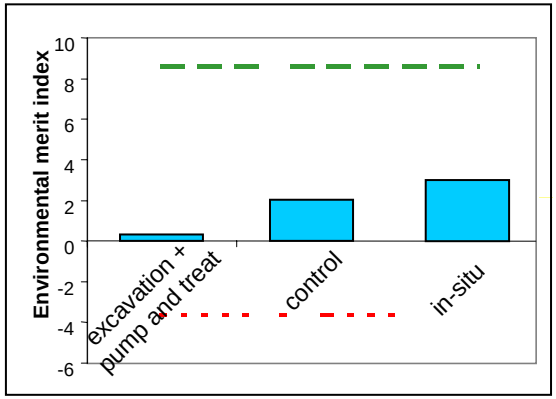
Result REC-model

Exposure to
- humans
- ecosystems
- other targets

Gain and losses
- environmental quality
- scarce resources
- emissions

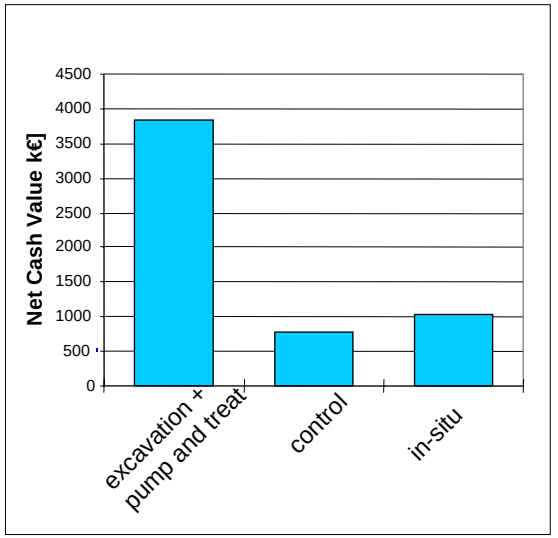
Costs
- continuous costs
- replacement/depreciation
- overheads,…





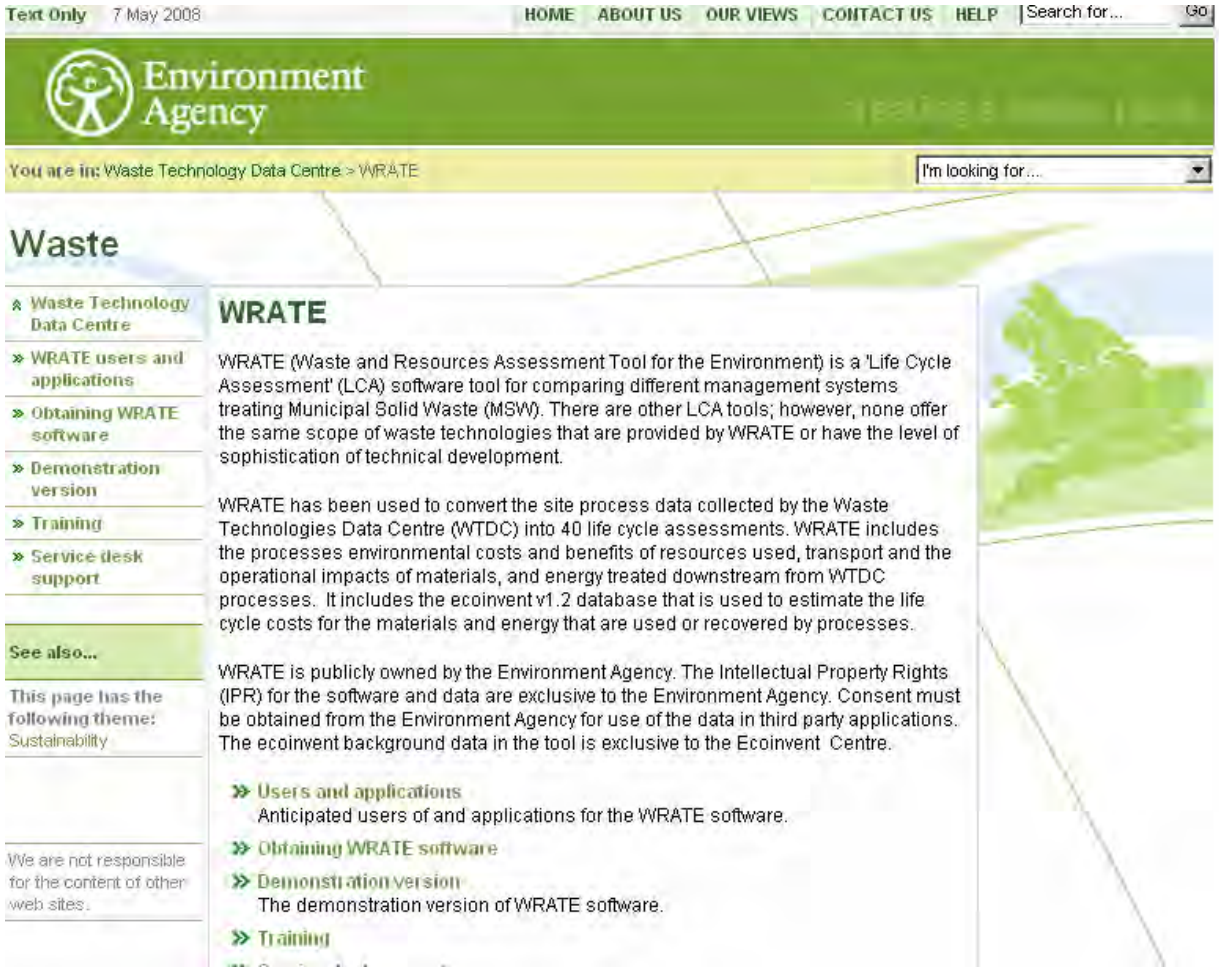
Theoretic maximum

MF-reference



SuRF SUSTAINABLE REMEDIATION FORUM UK

WRATE



Sinsheim system used a similar concept based on ~60 different remediation 'modules'

Universities of Nottingham and Cambridge: more general LCA to CLM studies

http://www.environment-agency.gov.uk/wtd/1396237/?lang=_e

LCA strengths and weaknesses

- Strengths
  - Standard methodologies exist (ISO, SETAC)
  - Accepted tool in environmental decision making and impact evaluation
  - Lends itself to modelling
  - Quantified findings *perhaps*
  - Very technical approach
- Weaknesses
  - The finding is highly dependent on subjective scope and boundary setting (e.g. LCA's of paper recycling)
  - Only deals with a segment of environmental impacts and does not consider economic or social sustainability issues
  - Procedures do not exist for key environmental impacts: e.g. on building conservation, landscape, biodiversity, soil functionality)
  - Lack of transparency and links to evidence may be tenuous e.g. where "standard values" are used

Carbon Footprint

- A measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide
- There are two parts to the measurement:
  - primary footprint is a measure of direct emissions of CO_2 from the burning of fossil fuels
  - secondary footprint is a measure of the indirect CO_2 emissions from the whole lifecycle
- No standardised method exists, but one is in development by the Carbon Trust 2007

C footprint strengths and weaknesses

- Strengths
  - Read across to carbon management policies (government and corporate)
  - Lends itself to modelling
  - Quantified findings *perhaps*
  - Very technical approach
- Weaknesses
  - The finding is highly dependent on subjective scope and boundary setting
  - Only deals a single aspect of environmental impacts
  - Lack of transparency and links to evidence may be tenuous e.g. where “standard values” are used