

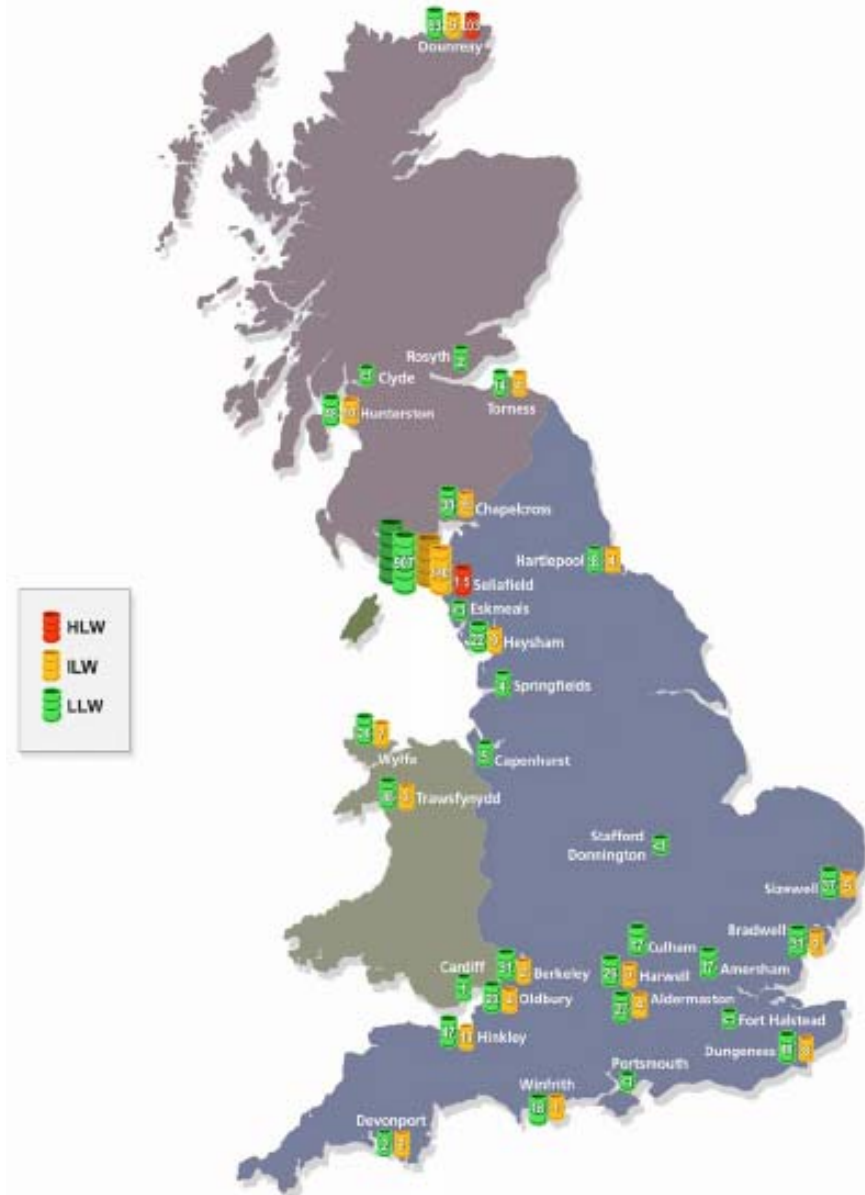
When Values Conflict: How citizens, stakeholders and experts contributed to formulating policy for managing the UK's radioactive waste

Professor Lawrence Phillips



Background

- Radioactive wastes are currently stored where they are produced.
- Storage is temporary, mainly above ground or at shallow depth.



Source: First CoRWM Annual Report (2004) 2



Sellafield –
the major
source of UK
radioactive
waste

Source: CoRWM document No. 1280

Storage of high level waste (HLW)

- Highly radioactive nitric acid solutions
- Remains radioactive for hundreds of thousands years
- Generates heat; store for 50 years for heat to fall
- Vitrified (converted into glass) put into stainless steel containers



Source: CoRWM document No. 1280

Store for HLW cannisters



Source: Nirex Report N/089

Intermediate level waste (ILW)

- Mainly materials irradiated in a nuclear reactor
- Stored in tanks, vaults and drums
- Immobilised in cement-based materials in drums

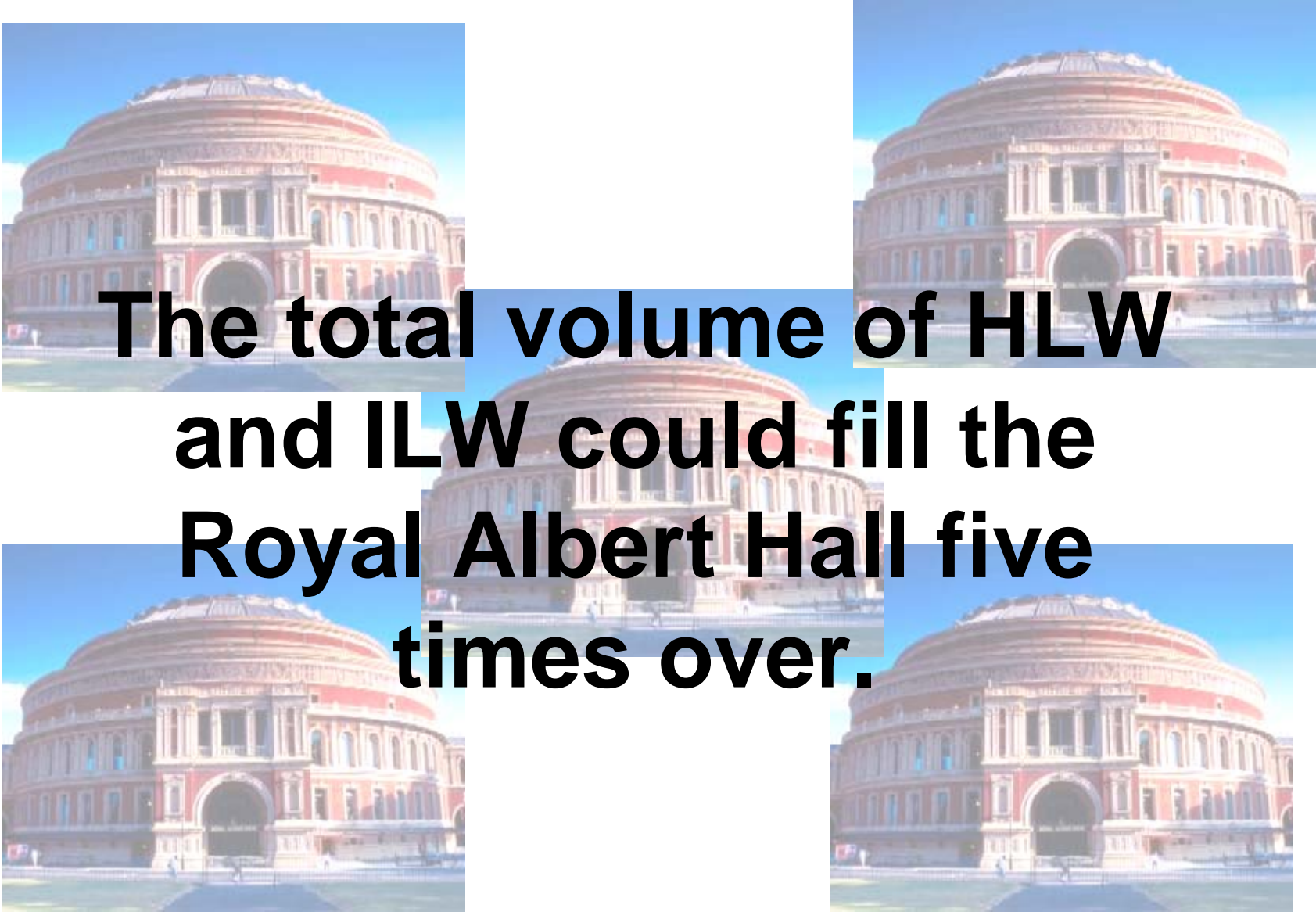


Source: CoRWM document No. 1280

Store for packaged ILW drums



Source: Nirex Report N/089



**The total volume of HLW
and ILW could fill the
Royal Albert Hall five
times over.**

What is the problem?

- There is no government policy for dealing with the wastes.
- Some radionuclides remain radioactive for thousands of years.
- In 1987 the government accepted deep disposal underground as the solution.
- Nirex explored possible sites, with the help of the LSE's Decision Analysis Unit, and eventually focussed on Sellafield.

What happened?

- Nirex's application in 1992 to build a rock characterisation facility to study the Sellafield geology was rejected in 1997.
- By 1999 the government realised the former approach of 'decide-announce-defend' was inappropriate.
- A new approach, scientifically and technically sound, involving citizens and stakeholders, was adopted.

Enter CoRWM

- Committee on Radioactive Waste Management formed by UK Government ministers in November 2003.
- To recommend long-term solution for managing HLW and ILW.
- Review of options to be open, transparent and inclusive.
- To “inspire public confidence.”

The Committee

- Chosen by Defra from applications.
- 13 members at start, diverse backgrounds, different perspectives on things nuclear.
- Professor Ortwin Renn persuades CoRWM to take an analytic-deliberative approach.
 - Involve the public
 - Engage stakeholders and specialists
 - Build trust

Controversy from the start

- One member sacked.
- David Ball resigns in protest.
- House of Lords Science and Technology Committee scathing about CoRWM (5th Report, 9/11/04).
- Michael Meacher calls for them to leave.
- David Ball (TCE, September 2005)
 - “The aura generated was one of anti-science...”
 - “Attempts to restore some sort of balance between the analytic and deliberative elements of CoRWM’s decision process were vigorously resisted.”
 - “...the lingering effects of post-modernism...”

Enter Catalyze

- 2 February 2005: I tell CoRWM sub-group they need a structured process; I suggest **MCDA** and **decision conferencing**.
- 21 March: Invitation to Tender.
 - “Multi-criteria Analysis (MCA) as a key input into its [CoWRM’s] decision-making”
 - “Teach-In” for CoRWM members explaining whole MCDA process
 - Three-stage process: define criteria, test scoring scheme, score the options

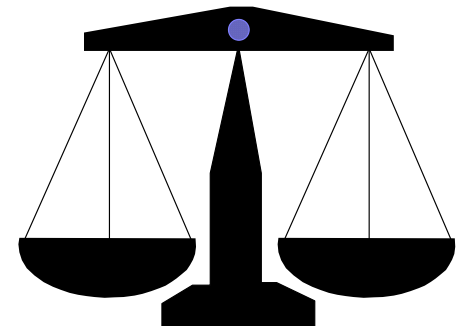
What is MCDA?

Multi-criteria decision analysis: an approach to appraising alternatives that differ on several criteria.



Accommodates hard data, facts, informed judgement and uncertainty.

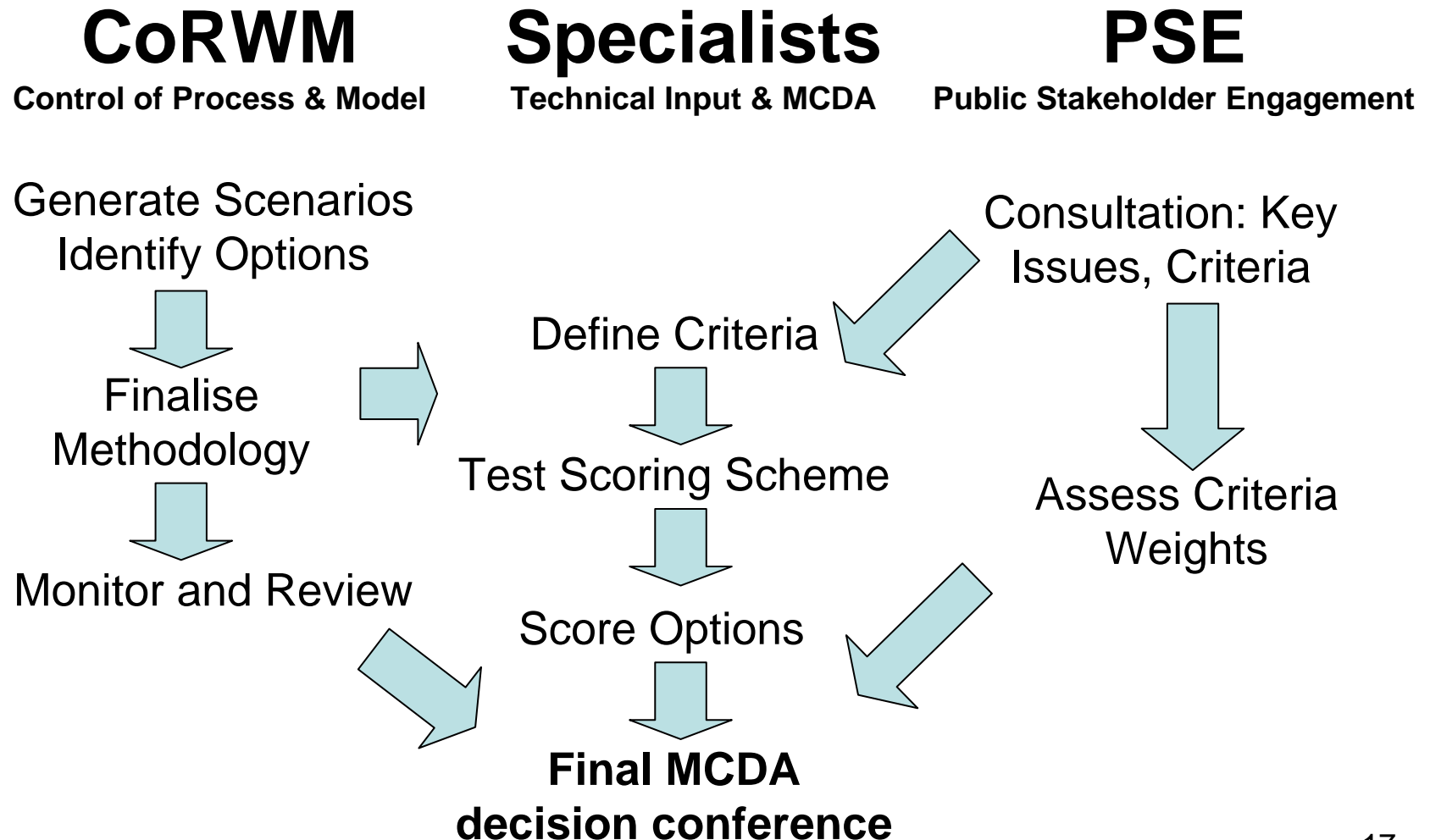
A theoretically sound way to compare apples and oranges using the common metric of *value added*.



What is Decision Conferencing?

- One or more workshops
- Attended by key players representing the diversity of perspectives
- Facilitated by an impartial specialist in group processes & decision analysis
- Using a requisite model created on-the-spot to help provide structure to thinking

Three parallel strands



The options

Storage options

1. Above ground, local, current protection
2. Above ground, central, current protection
3. Above ground, local, enhanced protection
4. Above ground, central, enhanced protection
5. Underground, local
6. Underground, central

Disposal options

1. Geological disposal
2. Boreholes
3. Phased geological disposal
4. Near surface, local
5. Near surface, central
6. Mounded over
7. Shallow vault, central
8. Shallow vault, local

Only these nine options are relevant for HLW.

Waste streams

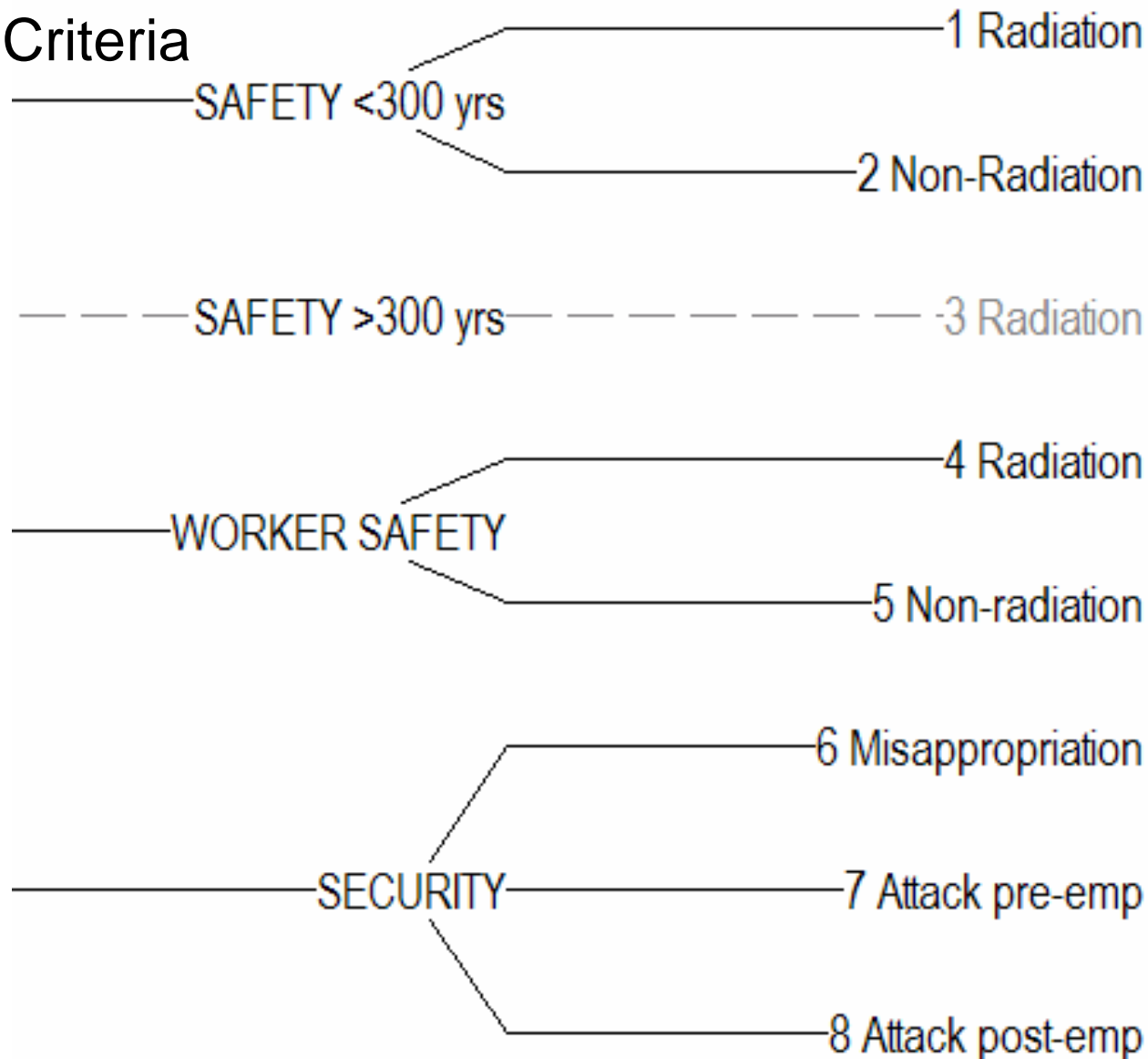
1. Spent nuclear fuel
2. High level waste
3. Plutonium
4. Highly enriched uranium
5. Reactor decommissioning wastes
6. Depleted, natural and low enriched uranium
7. Intermediate level waste and low level waste that isn't suitable for shallow burial at Drigg

Headline criteria

1. SAFETY, SHORT TERM (<300 YEARS)
2. SAFETY, LONG TERM (>300 YEARS)
3. WORKER SAFETY
4. SECURITY
5. ENVIRONMENT
6. SOCIO-ECONOMIC
7. AMENITY
8. BURDEN ON FUTURE GENERATIONS
9. IMPLEMENTABILITY
10. FLEXIBILITY
11. COST

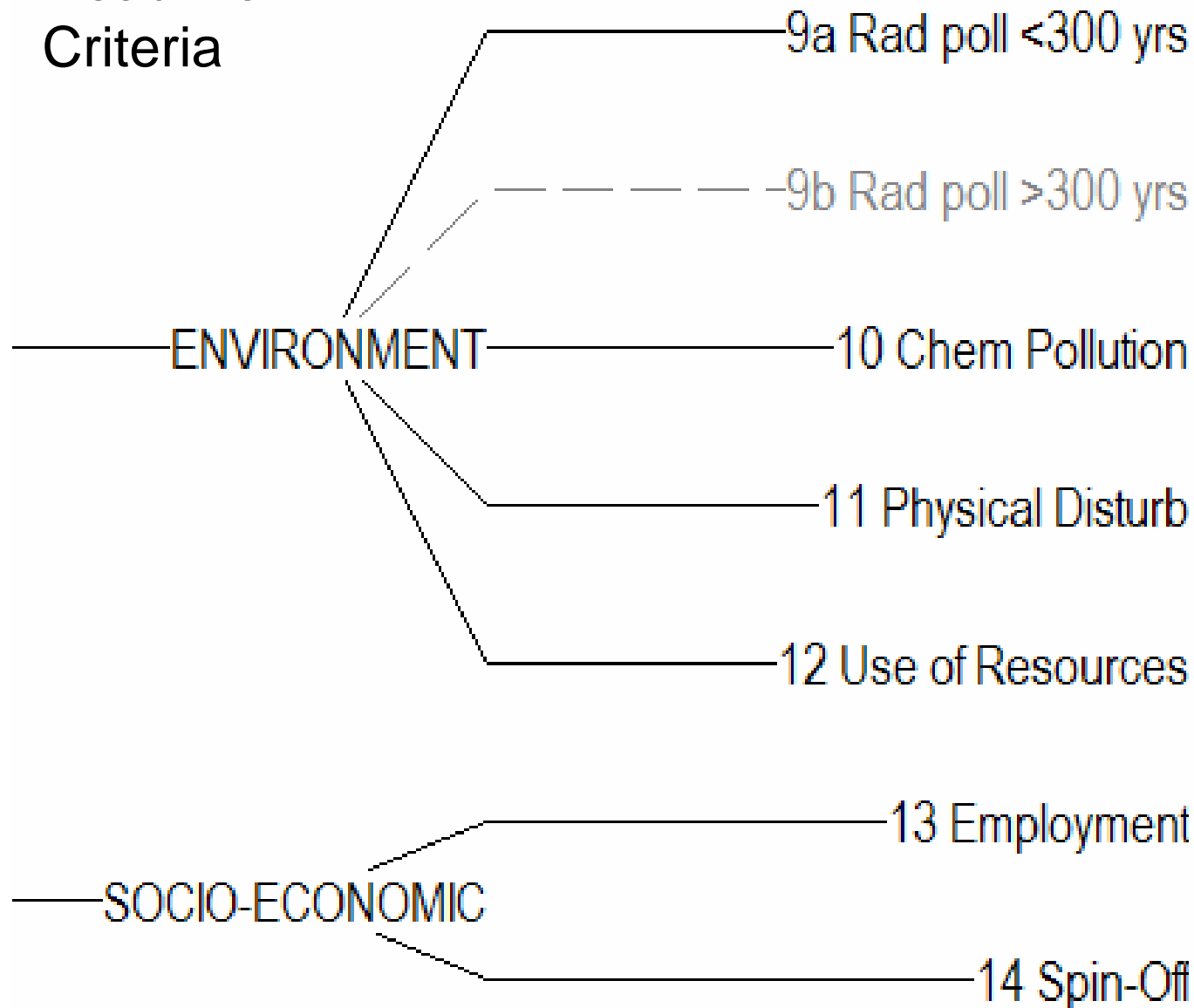
Headline

Criteria



Sub-
Criteria
1 - 8

Headline Criteria



Sub-
Criteria
9 - 14

Headline Criteria

AMENITY

15 Visual

16 Noise

17 Transport

18 Land Take

Sub-
Criteria
15 - 22

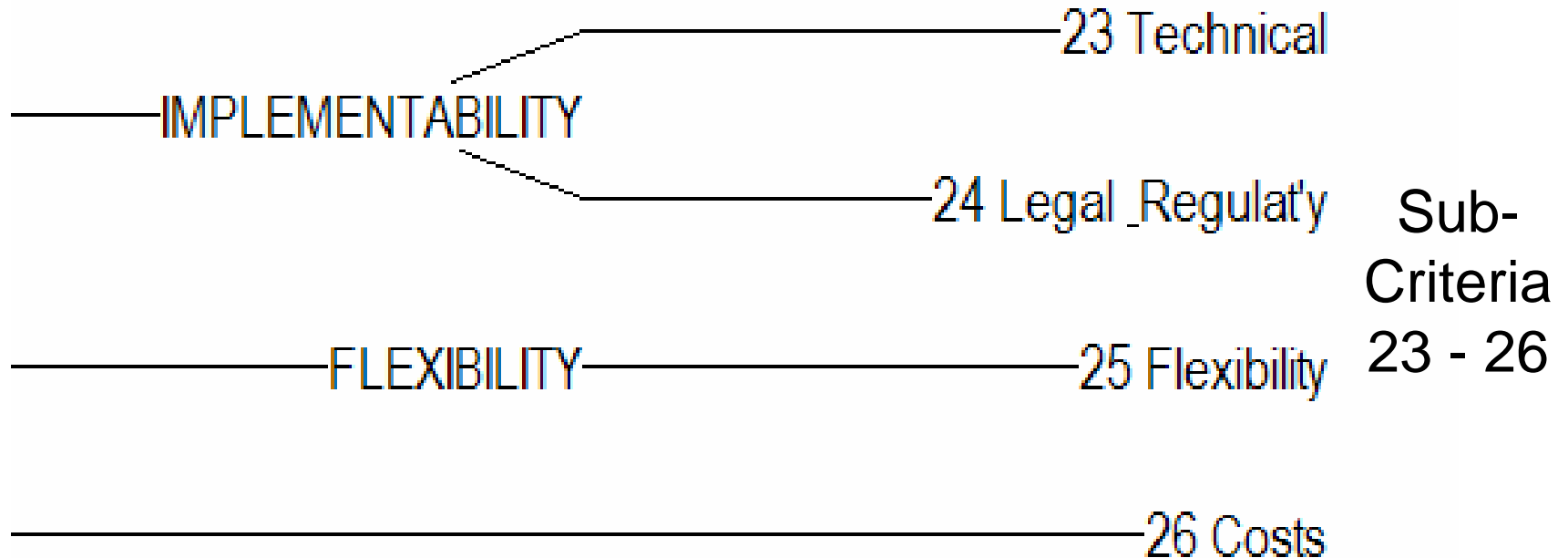
BURDEN ON FUT GEN

19 20 Costs _Effort

21 Worker Dose

22 Environm'l impact

Headline Criteria



Defining the sub-criteria

<i>Sub-Criterion 1: Radiation</i>	
The extent to which an option is expected to protect individual members of the public from exposure to radiation during the first 300 years.	
9 inherently resilient to possible adverse events	System continues to operate within its design envelope for all reasonably foreseeable non-malicious hazardous events
:	
1 very poor resilience – readily fails challenge associated with any one of several foreseeable events by substantial margin	Option fails to maintain protection by a substantial margin beyond the defined reference level under any one of a range of reasonably foreseeable hazardous events, requiring significant and time-consuming corrective action in order to recover.

Defining the sub-criteria

Sub-Criterion 25: Flexibility

Extent to which the option is expected to allow for future choice and respond to unforeseen or changed circumstances over the 300-year time span.

9	System is fully monitored and adaptable, and the waste is easily retrievable using the existing system
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5	Some system elements can be monitored, adaptability is limited, and waste retrieval is moderately difficult
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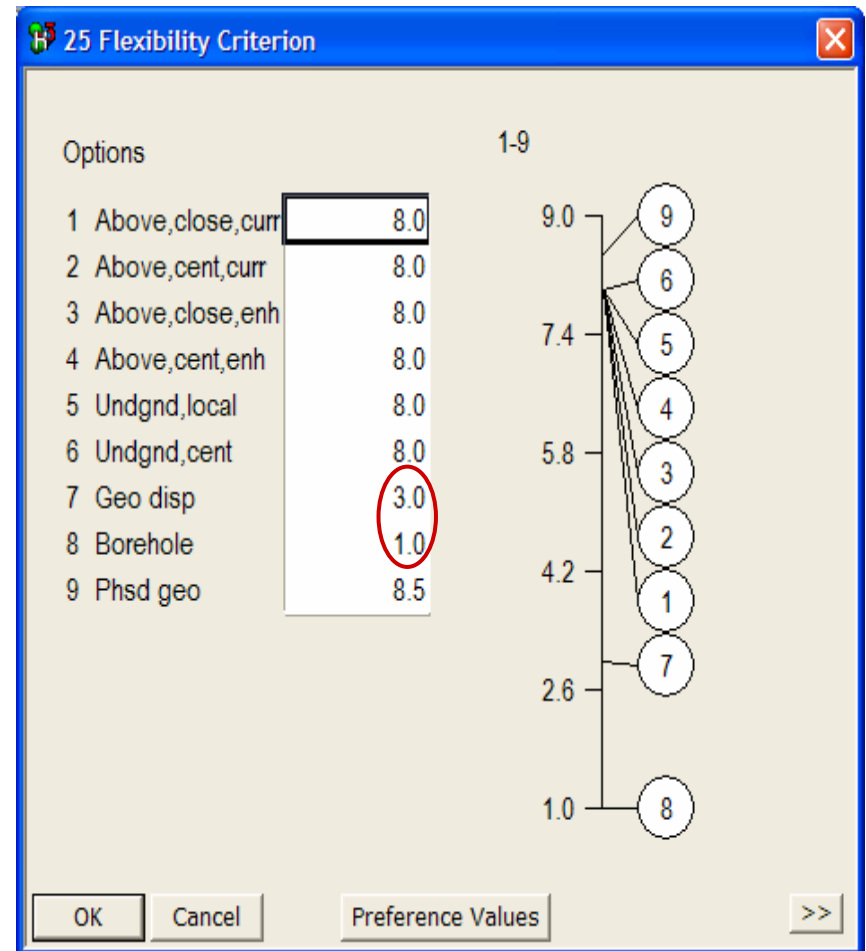
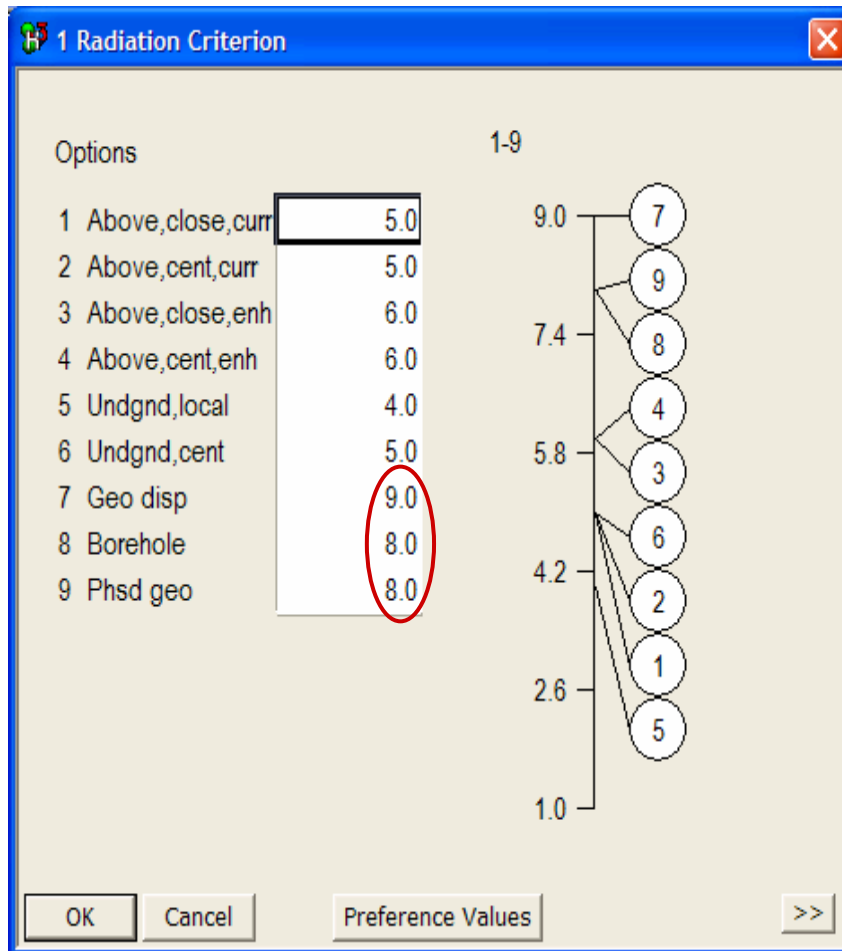
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1	Monitoring options is severely restricted, the system is not adaptable, and waste retrieval is very difficult
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Scoring the options

- Specialists defined criteria in summer 2005.
- Same specialists scored the options late in 2005, again in workshops.
- Nominal group technique applied to counter potential bias.
 - Make mental note of your preference score
 - Reveal score to group
 - Most extreme people discuss
 - Group discuss to consensus – a score or range.

Radiation (<300 yrs) & Flexibility



Weighting the criteria

- Public consultation provided weights or views about weights.
- Swing-weighting emphasised throughout: “How big is the difference from point 1 to point 9 on this scale, and how much do you care about it?”
- 28 - 30 March 2006: Decision conference with CoRWM members to assess weights, examine results, conduct sensitivity analyses.

Weighting the criteria

Compare swings in added value from 1 to 9.

Sub Criterion 1: Radiation

9 inherently resilient to possible adverse events

⋮

1 very poor resilience – readily fails challenge associated with any one of several foreseeable events by substantial margin

Sub Criterion 25: Flexibility

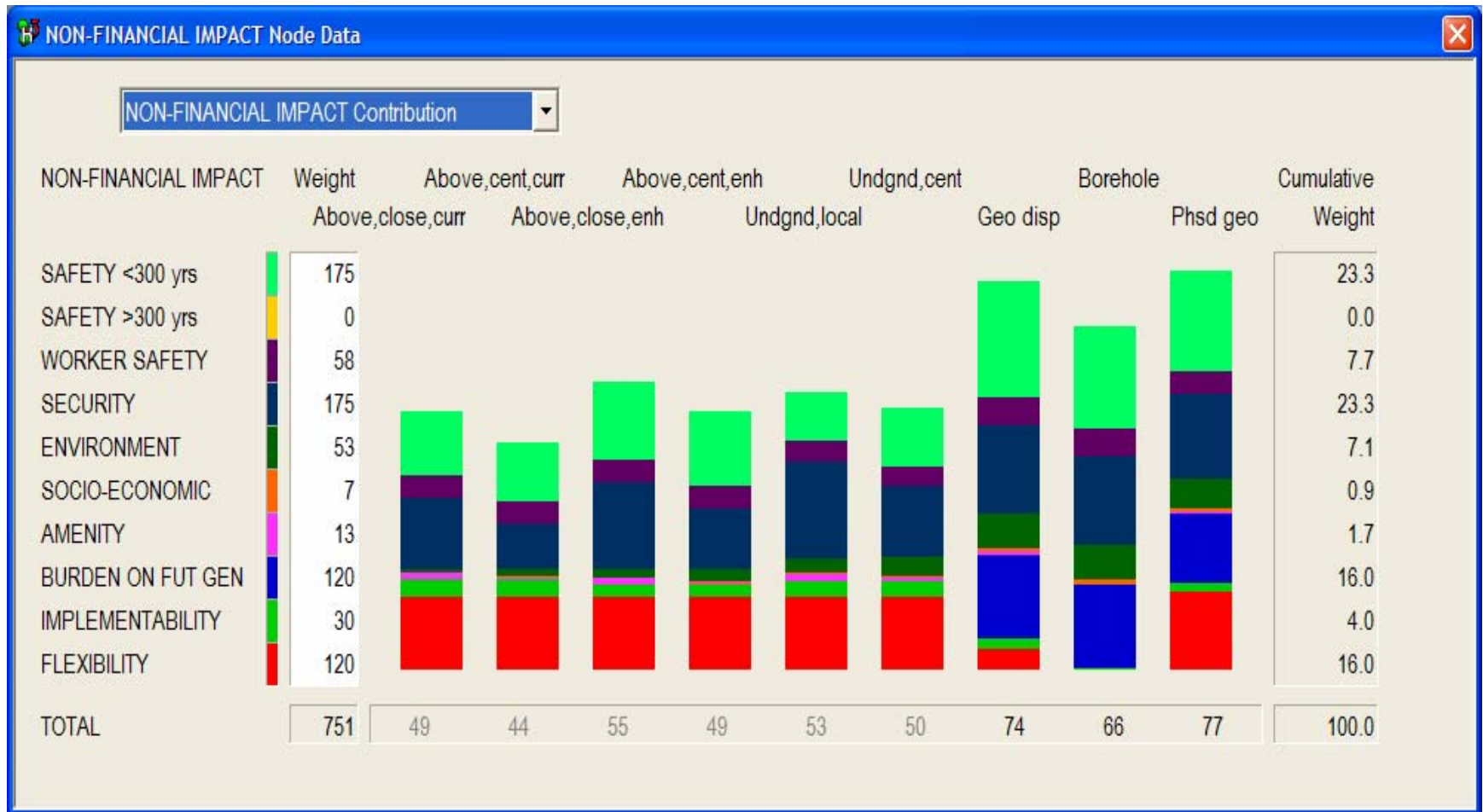
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⋮

1 Monitoring options is severely restricted, the system is not adaptable, and waste retrieval is very difficult

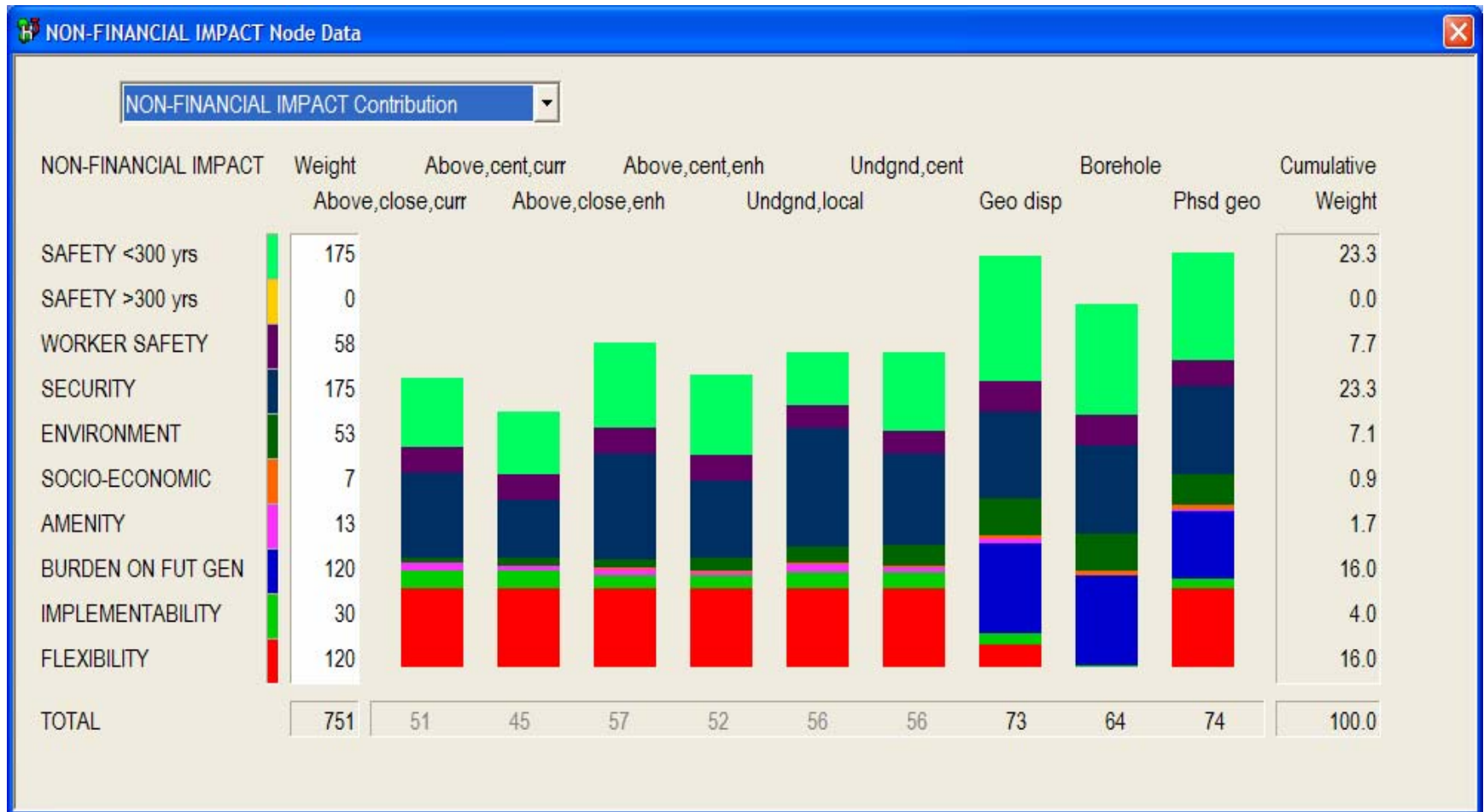
How big is the 1 to 9 difference, and how much do you care about it?

Results for HLW

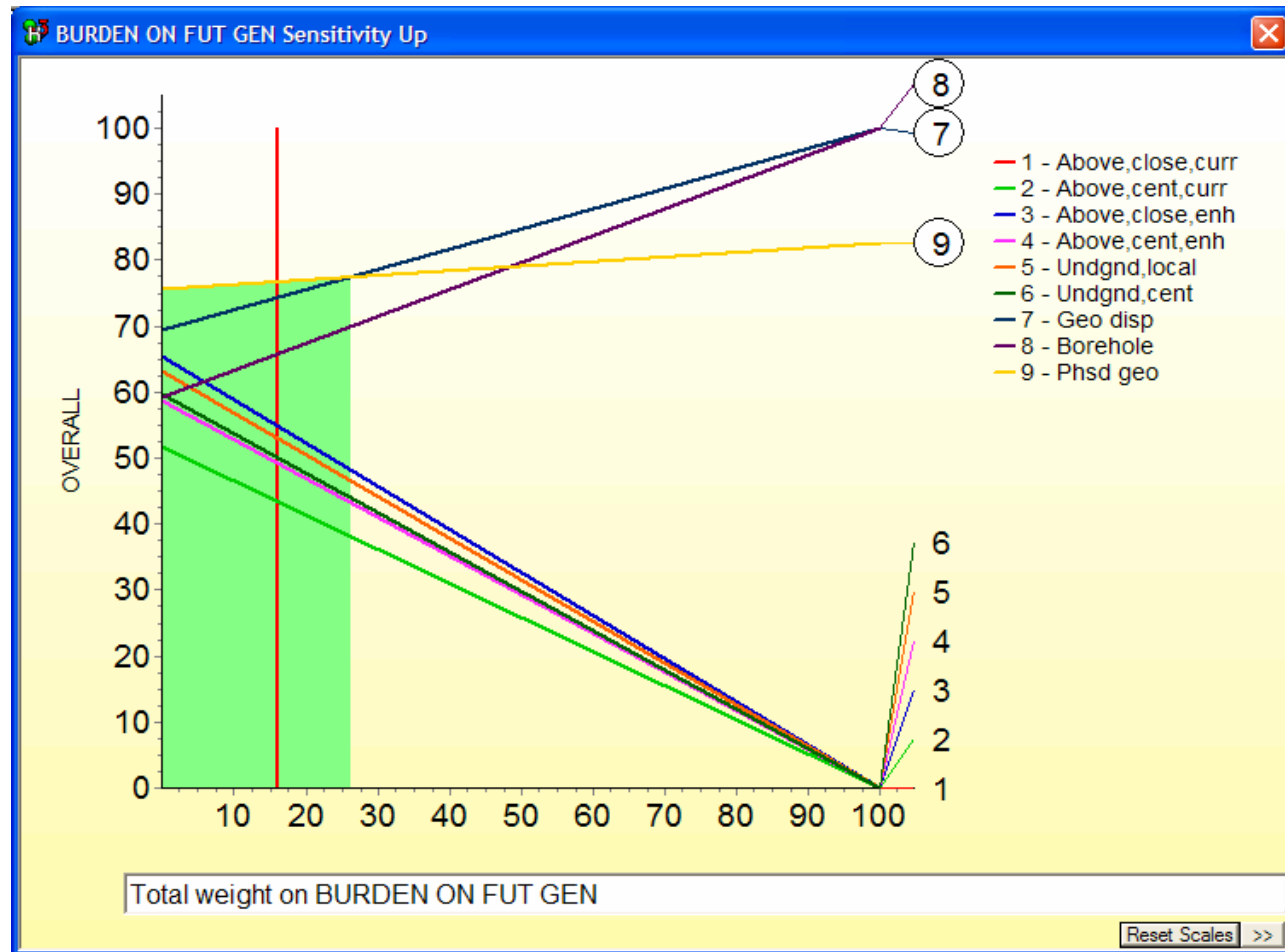


Uncertainty analysis

Optimistic scores for storage options, pessimistic ones for disposal options.

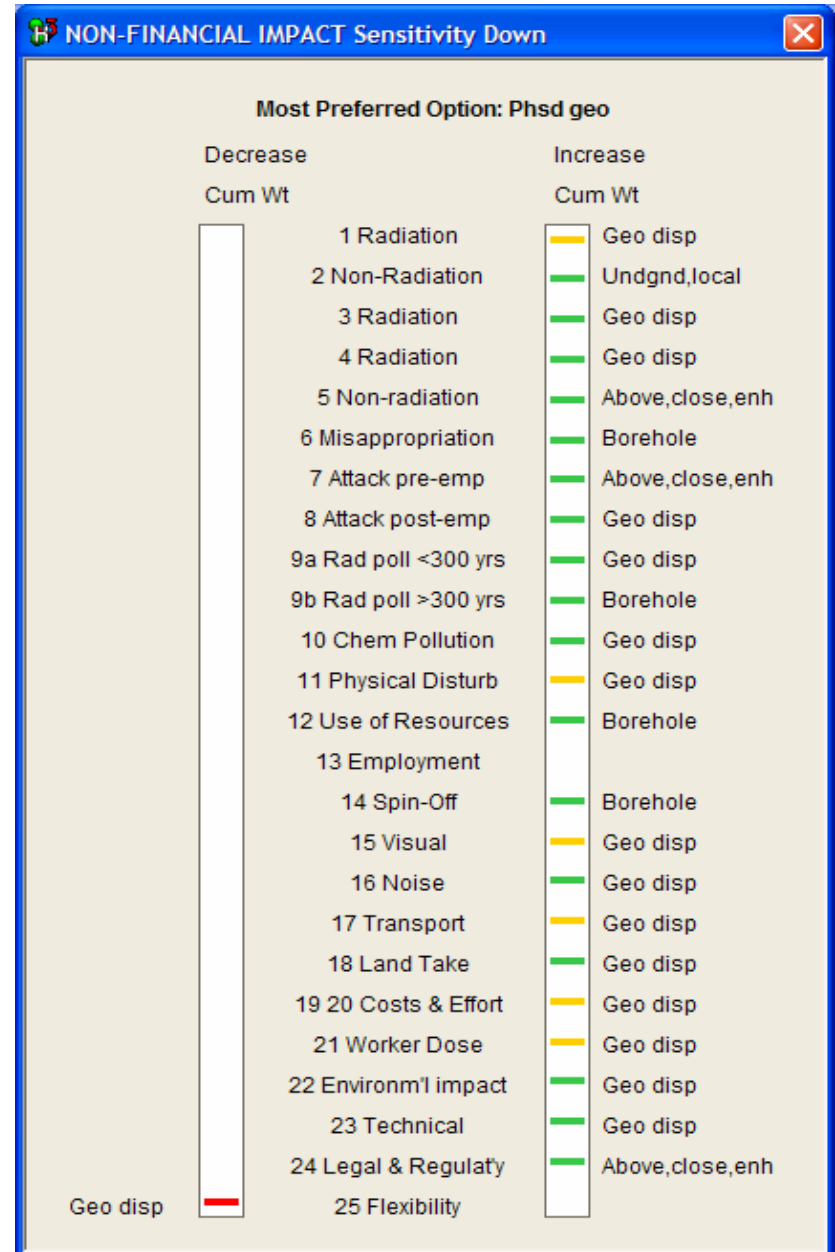


Sensitivity analysis on Burden



Sub-criteria sensitivities

- How much change in weight is required to favour a different option:
 - Green: >15 points
 - Yellow: 5-15 points
 - Red: <5 points
- Only the weight on Flexibility is crucial



Other perspectives

Blue: 1st choice

Yellow: 2nd choice Option

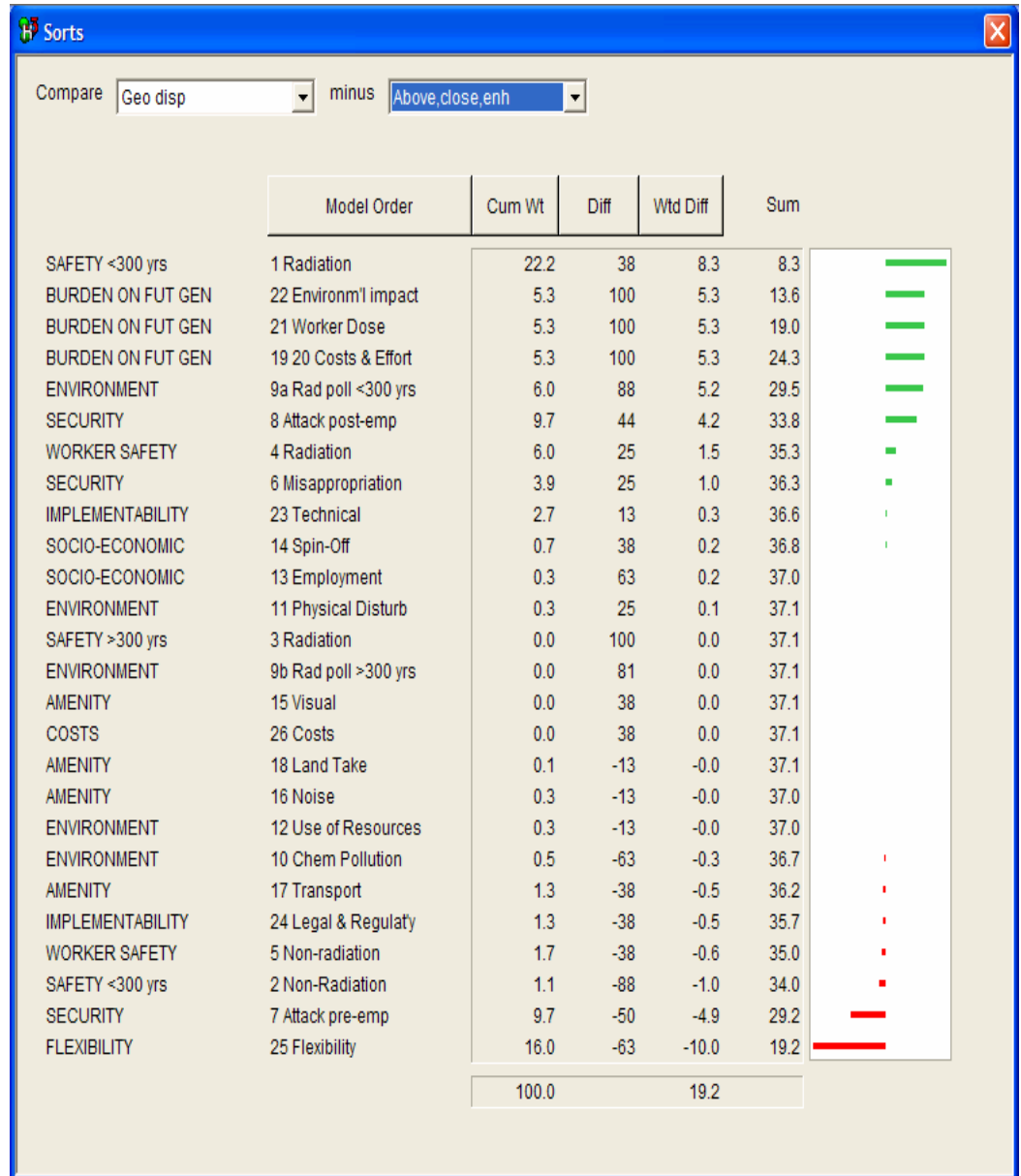
Sector trends	1 Above,close,curr	2 Above,cent,curr	3 Above,close,enh	4 Above,cent,enh	5 Undgnd,local	6 Undgnd,cent	7 Geo disposal	8 Borehole	9 Phased Geo
Base case	49	44	55	49	53	50	74	66	77
Older citizens	53	47	59	54	59	57	72	64	75
Younger citizens	38	33	45	41	45	45	84	80	74
Local Gov'ts & Communities	54	47	56	49	57	53	68	54	69
NGOs	52	45	55	48	57	53	58	44	47
Non-Dept'l Gov't Bodies	47	44	50	47	53	52	77	64	74
Gibb	49	44	55	49	53	50	74	68	77
Learned Societies	49	44	55	49	53	50	74	66	77
Environment Agency EA	47	44	54	50	54	53	77	67	78
Environment Agency SEPA	47	44	54	50	54	53	76	67	78

A surprisingly robust result!

Try it yourself! MCDA report, models & access to 20-day Hiview3 at <http://www.corwm.org/content-1041>.

Why?

- Disposal advantages (green bars) overbalanced storage advantages (red bars).
- This allowed differences of opinion to be maintained while the group agreed the way forward.



CoRWM final recommendations

- Some form of geological disposal
- Further research on geological disposal
- Safe and secure management of wastes through improved interim storage until disposal system developed
- Community involvement in siting
- Open and transparent process of implementation

What have I learned?

- Rational debate can be achieved within a deliberative discourse process.
- The process must provide structure for the debate: that was the role of MCDA.
- Technical processes are not sufficient: design of the social process is crucial.
- Values are constructed throughout the deliberative process, even with experts.

With grateful thanks to...

- Prof Gordon MacKerron and the entire CoRWM membership.
- NNC for organising us all.
- Numerous sub-contractors & specialists.
- My colleagues:
 - Bob Kitchen, Catalyze
 - Mara Airoidi, Catalyze
 - Mike Egan, Quintessa