An Abbreviated Application of the NWMO Assessment Team Model

September 24, 2005

NWMO Assessment Team

Agenda

1. **Overview**
2. **Score the alternative management approaches**
3. **Assign weights**
4. **Compute and review results**

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Workshop objectives:

1. **Provide a thorough understanding of the assessment process used by the NWMO Assessment Team.**

2. **If possible, obtain an independent comparative evaluation of the 3 management alternatives that were evaluated by the Team.**

The Assessment Team conducted its assessment in a series of meetings over several months. It will be a challenge to repeat the effort in a 1-day workshop.

The Team used the methodology known as multi-attribute utility analysis (MUA)

- **Useful for decisions involving multiple objectives.**
- **Much application experience.**
- **Highly regarded by specialists.**

Multi-attribute utility analysis…is in my view the best approach for analysis of complex and high stakes decisions. "

University of British Columbia Professor Tim McDaniels

"… the multi-attribute utility method …is a satisfactory and appropriate decision-aiding tool. "

United States National Academy of Sciences

"…no model for how individuals should make…choices is without critics, [but] the one that comes closest to universal acceptance is …multi-attribute utility."

Office of the Deputy Prime Minister, British Government

Key assumptions and characteristics

- **Assumes:**
  - **"The best approach is the one that we believe will best achieve our objectives."**
  - **Analysis (breaking a problem into its components, analyzing those components, and using logic to draw conclusions) aids decision making (i.e., constructing and analyzing an analytical model of the decision).**
- **The model distinguishes two types of judgments required to make policy decisions:**
  - **Technical judgments (if we choose this approach, what are the likely health, environmental, economic, etc. consequences?)**
  - **Value judgments (on which of our objectives is it most important to have good performance?)**

"All models are wrong, but some are useful."

George Box

The team believed that MUA would help them to:

1. **Account for important issues and concerns**
   - **because it forces a comprehensive, systematic consideration and can include virtually any objective that people feel is important**
2. **Document their assumptions, judgments, opinions, and reasoning**
   - **because the model makes all such inputs explicit**
3. **Be sensitive to alternative values**
   - **because the weights can be varied to show how the choice might change depending on value judgments that are made**
4. **Discriminate among the options**
5. **Serve as an aid for drawing conclusions.**

However, applying the methodology takes skill

- **There are numerous technical requirements that must be met to ensure that results follow logically from inputs**
  - **Choosing objectives that do not overlay and can be weighted.**
  - **Assessing performance against objectives.**
  - **Assigning weights.**
- **Furthermore, application of this (or any other) methodology to Canada's choice of an approach presents unique challenges.**
  - **Uncertainty.**
  - **Extremely long time frame.**
  - **Unknown objectives and values of future generations.**
  - **Need to rely extensively on best professional judgment.**

The methodology was applied in a series of steps

1
Create a hierarchy of (non-overlapping, fundamental) objectives

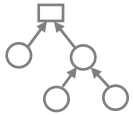
2
Construct diagrams identifying factors influencing ability to achieve objectives

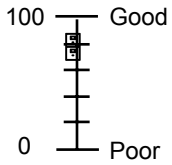
3
Estimate how well each approach would perform against each objective

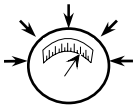
4
Assign value weights (indicating the relative importance of the objectives)

5
Combine performance estimates and weights

6
Draw conclusions

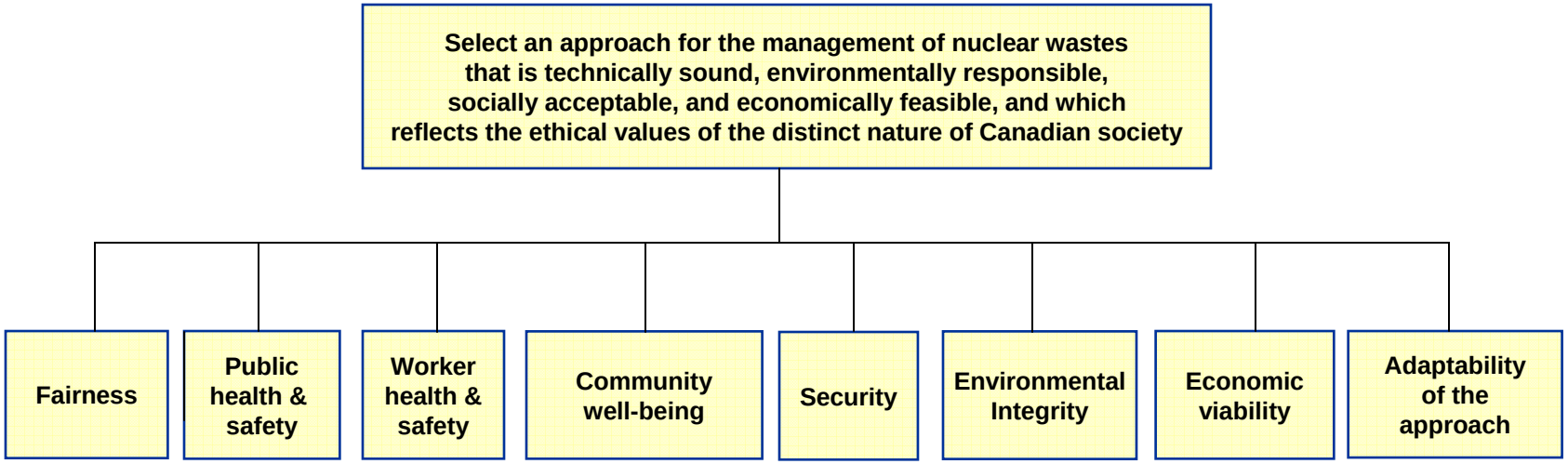






The Team used the methodology as an aid, not as a decision making tool.

Step 1: Hierarchy of objectives



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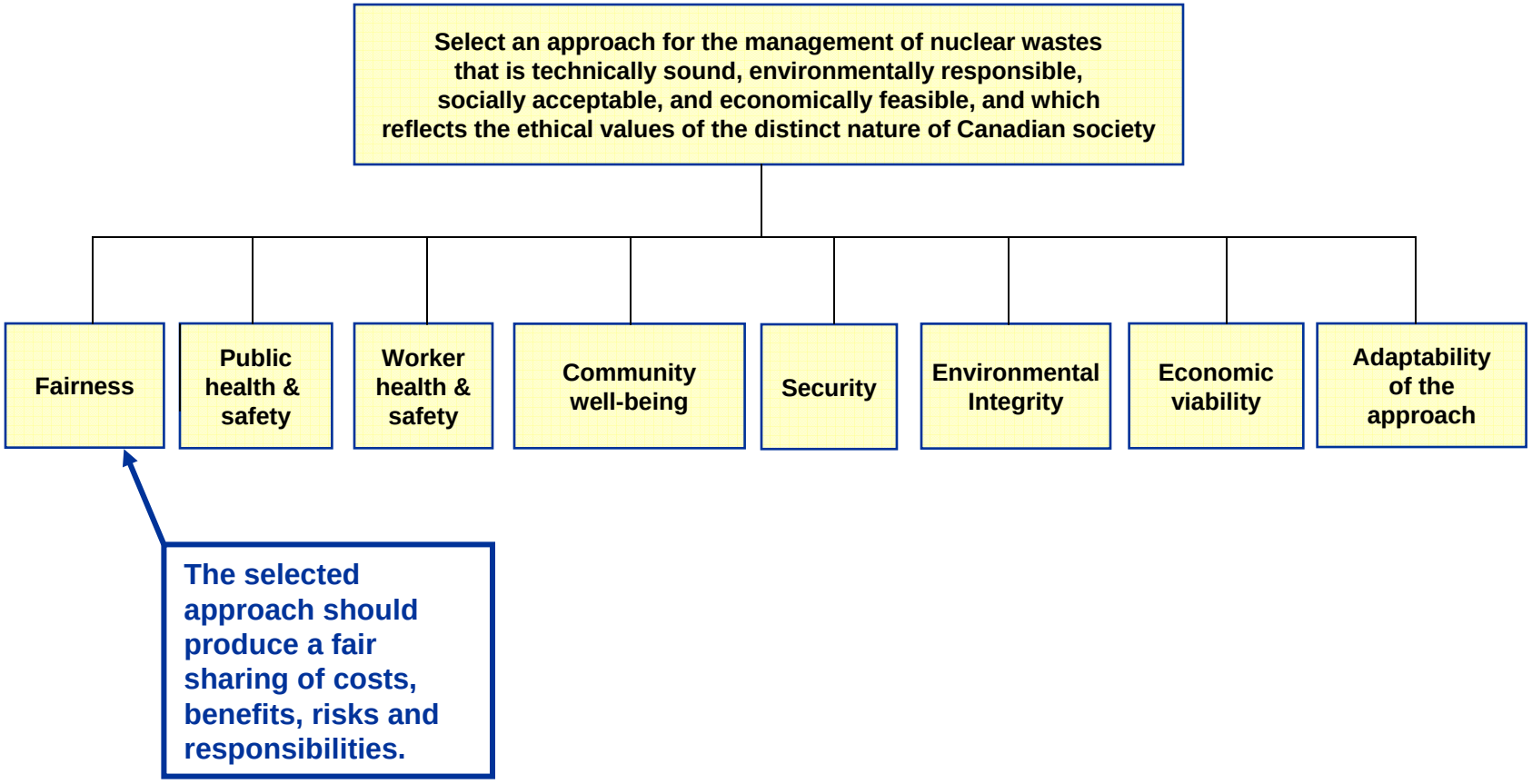

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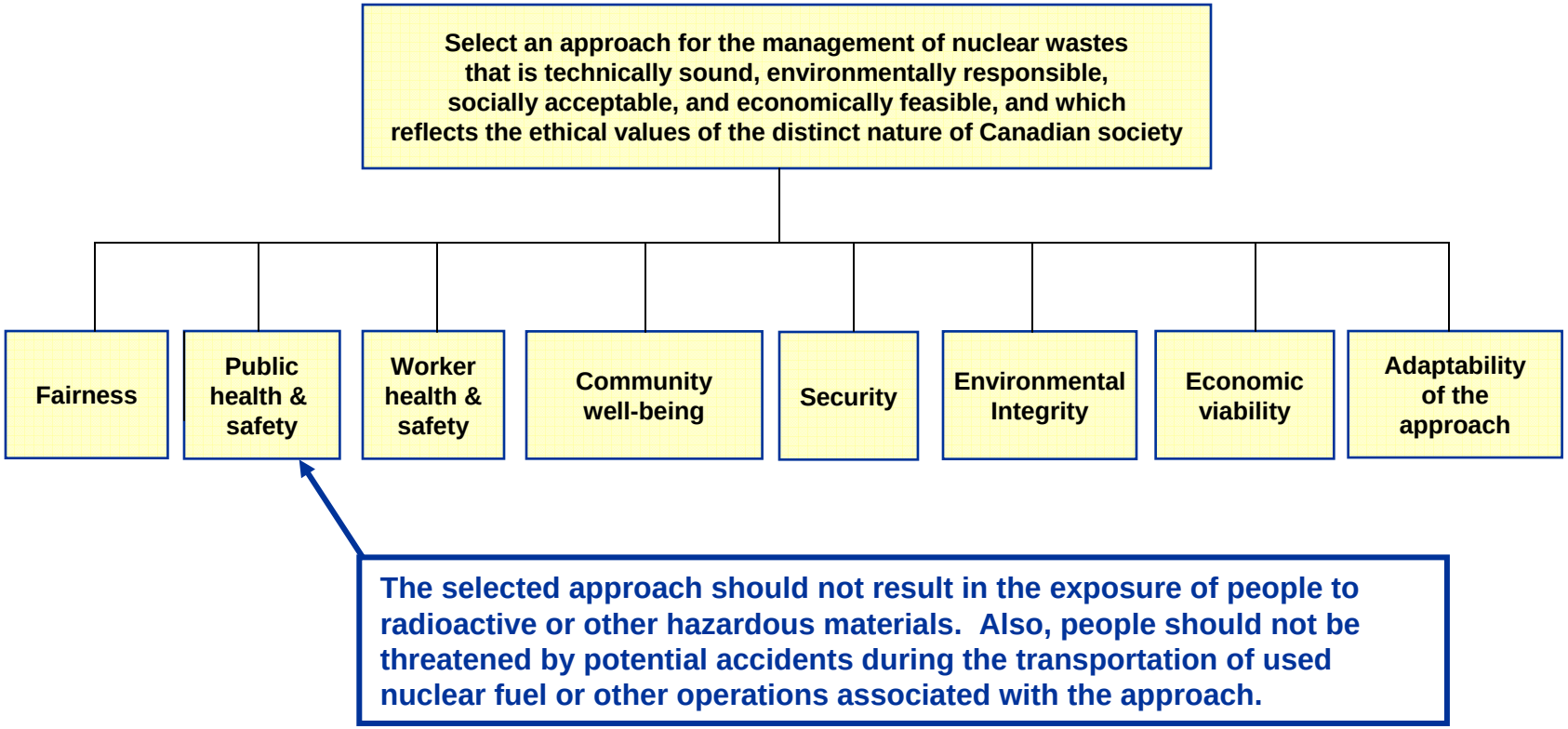

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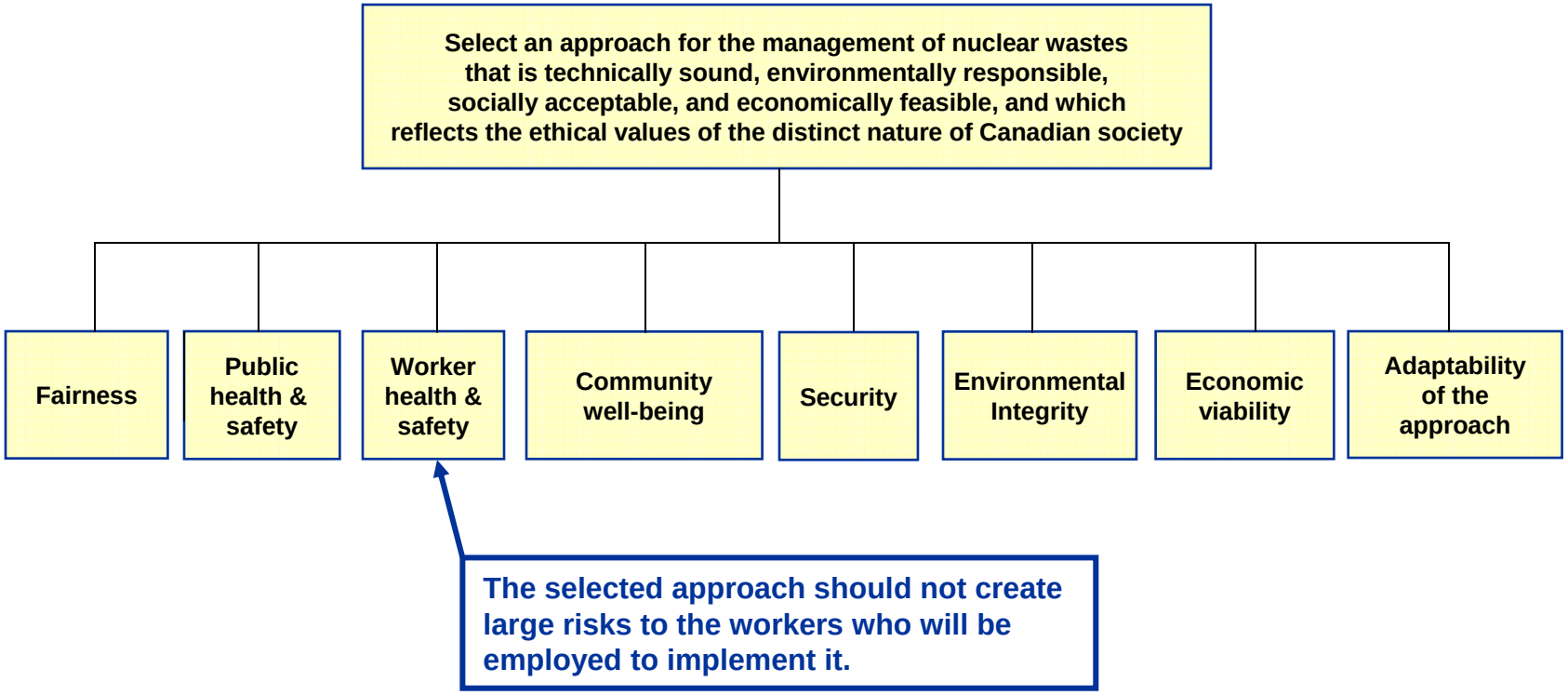

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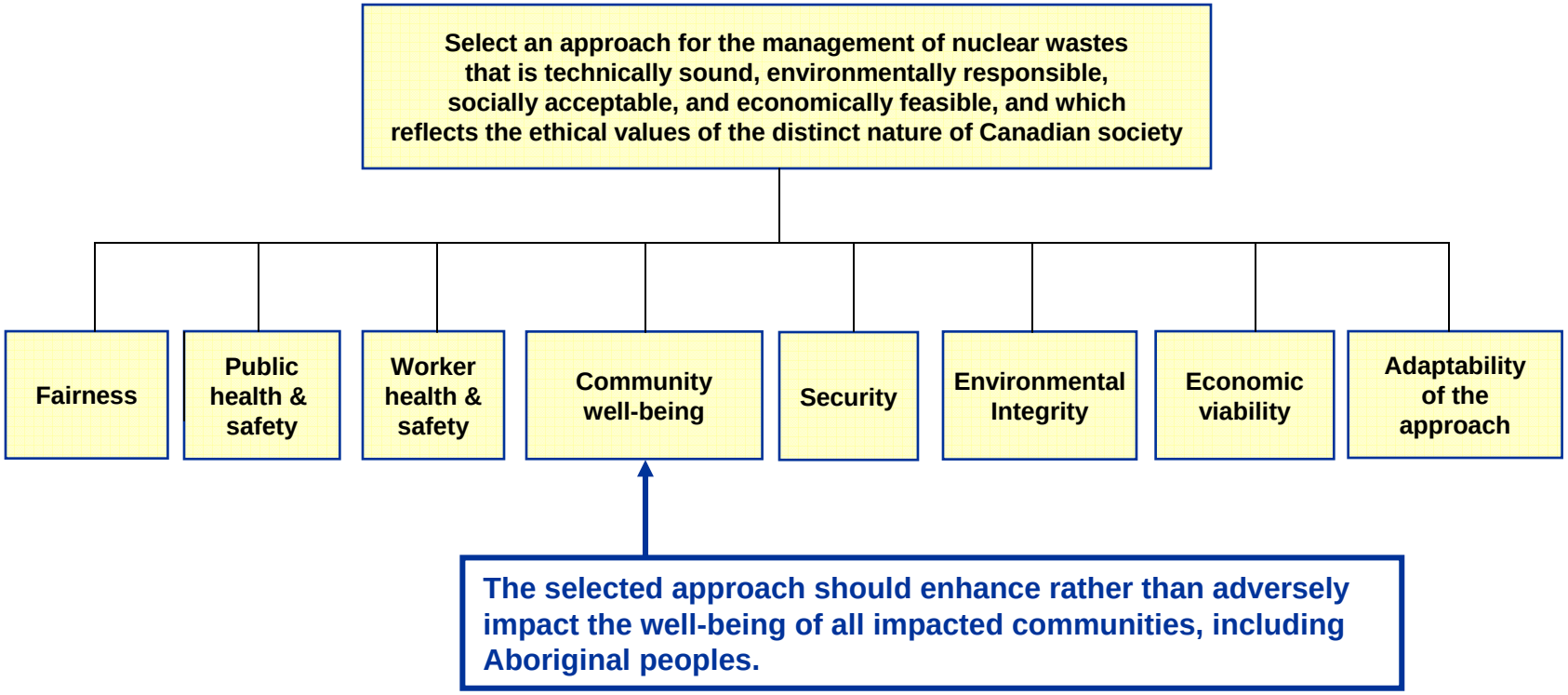

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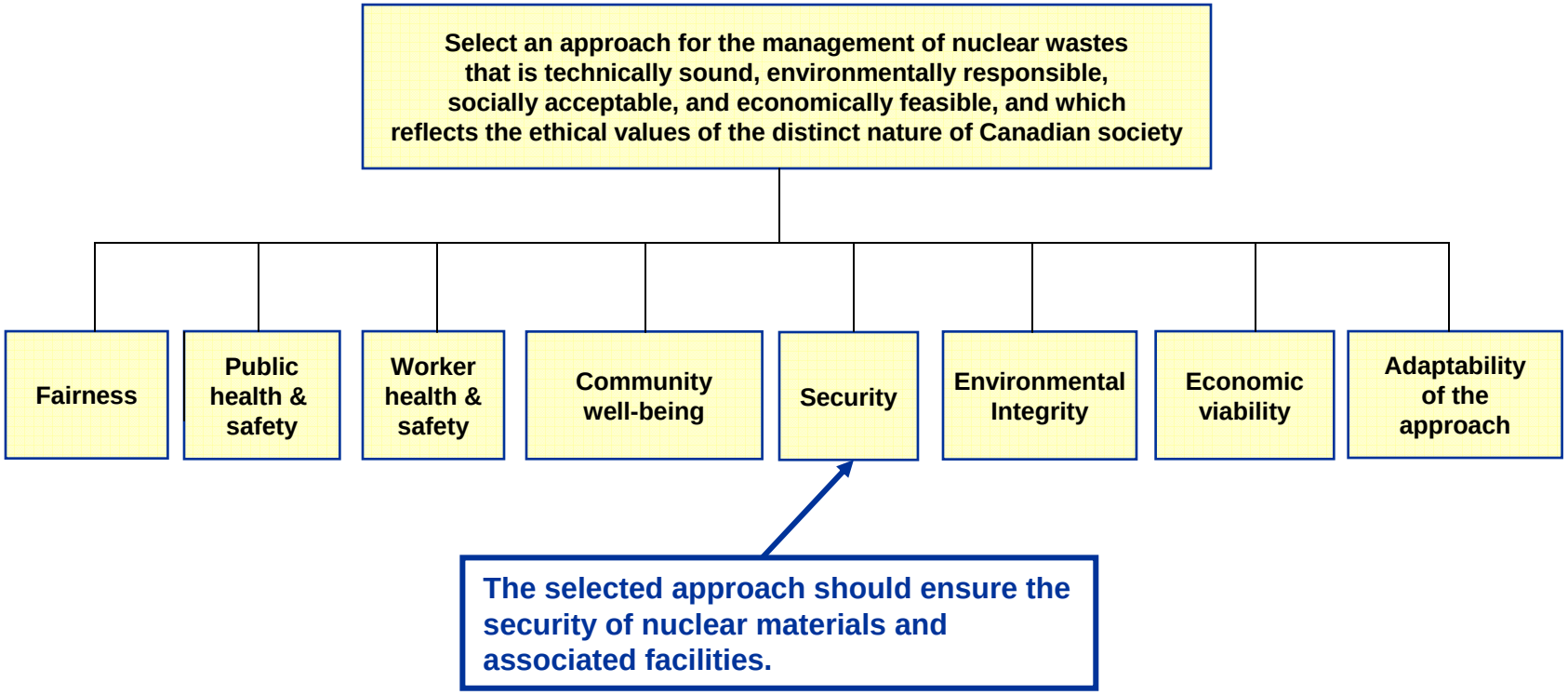

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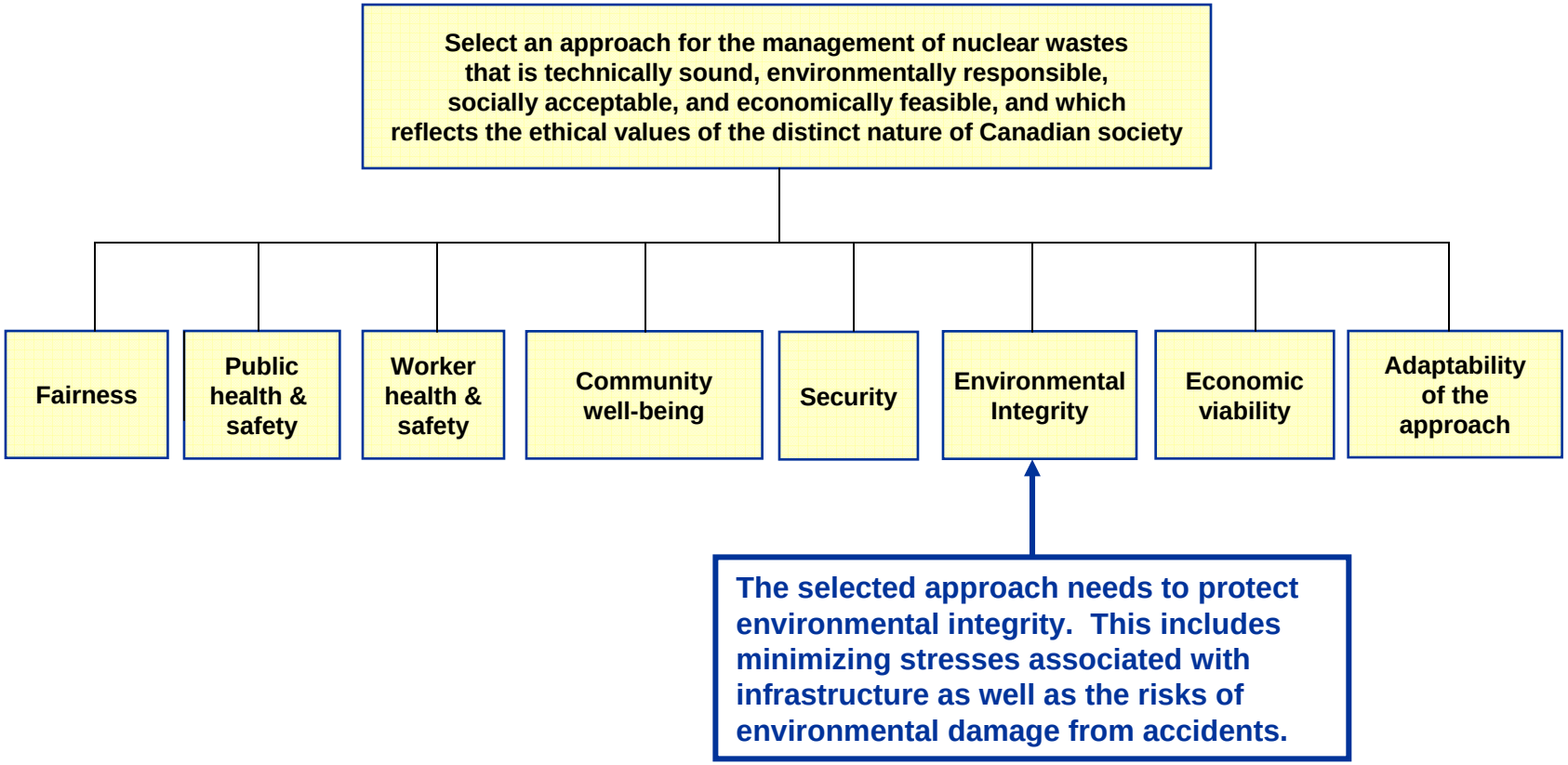

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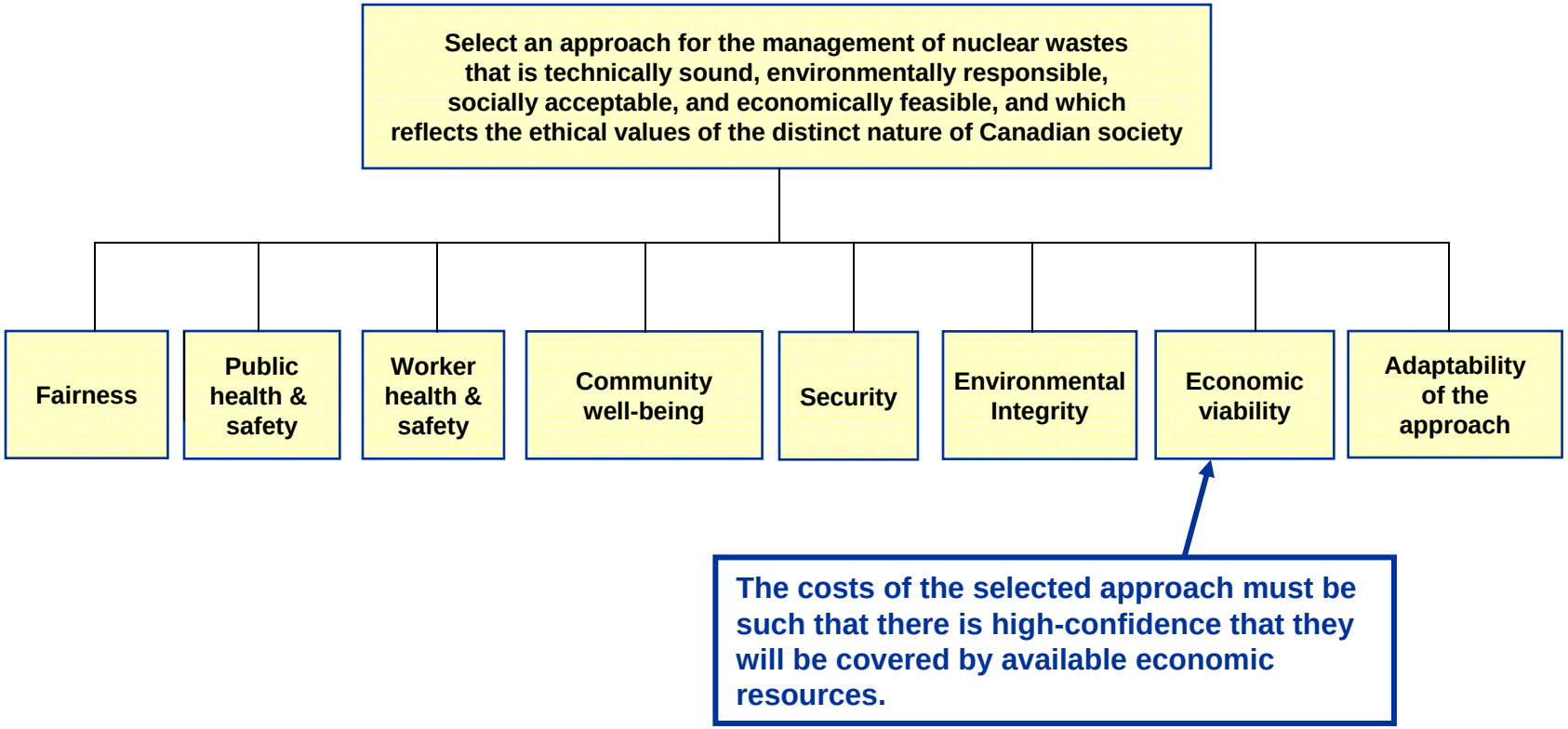

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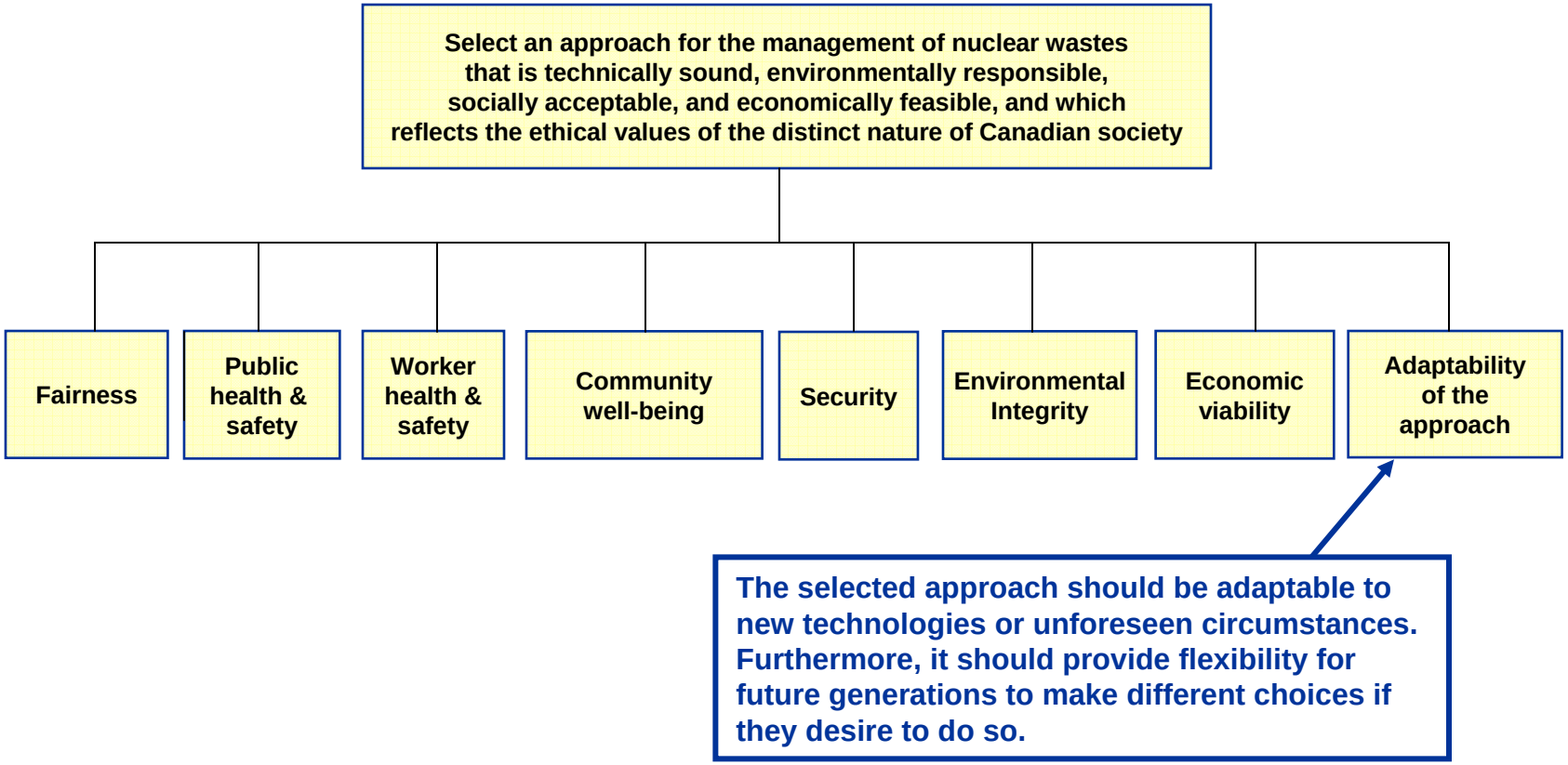
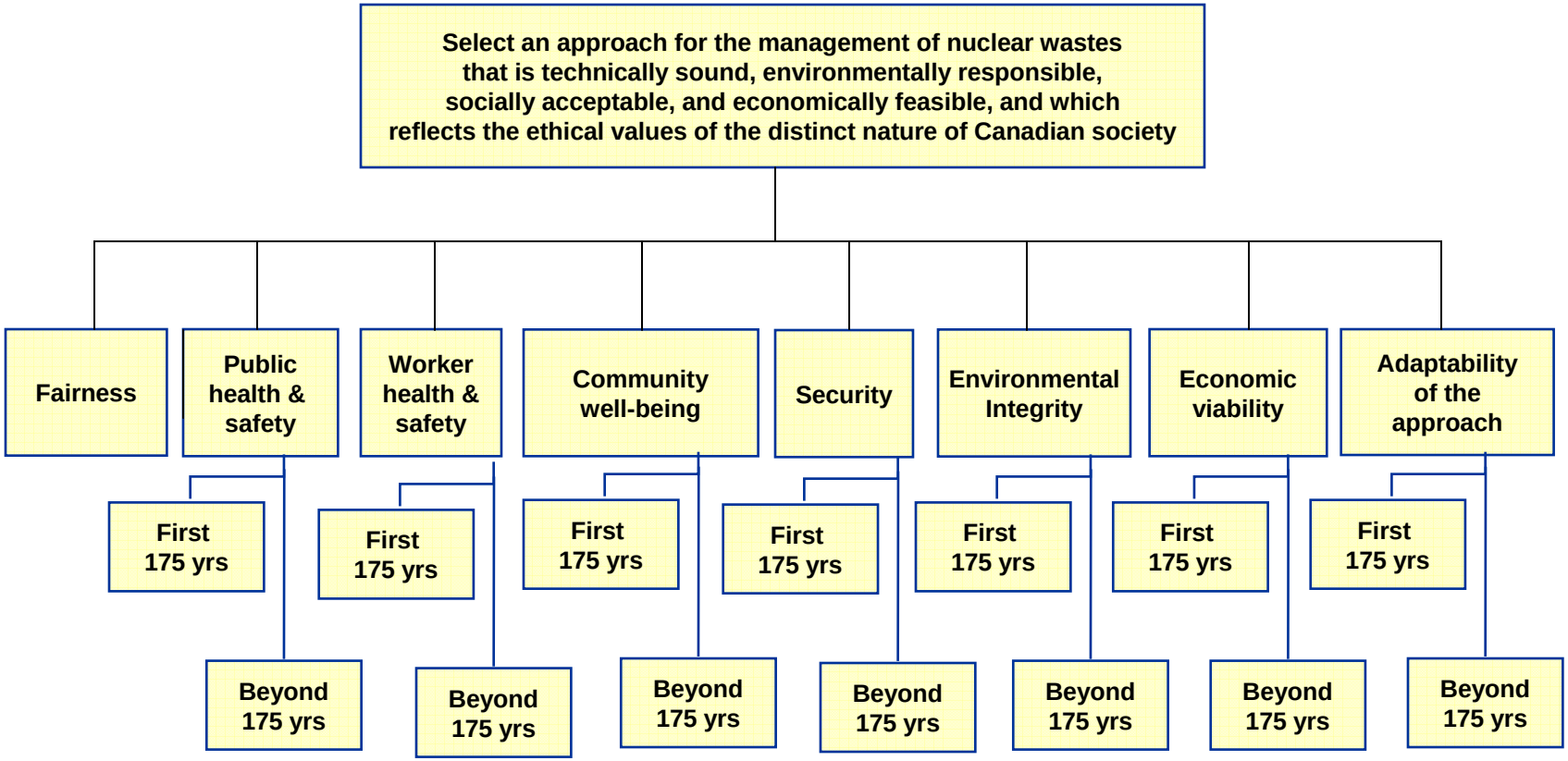


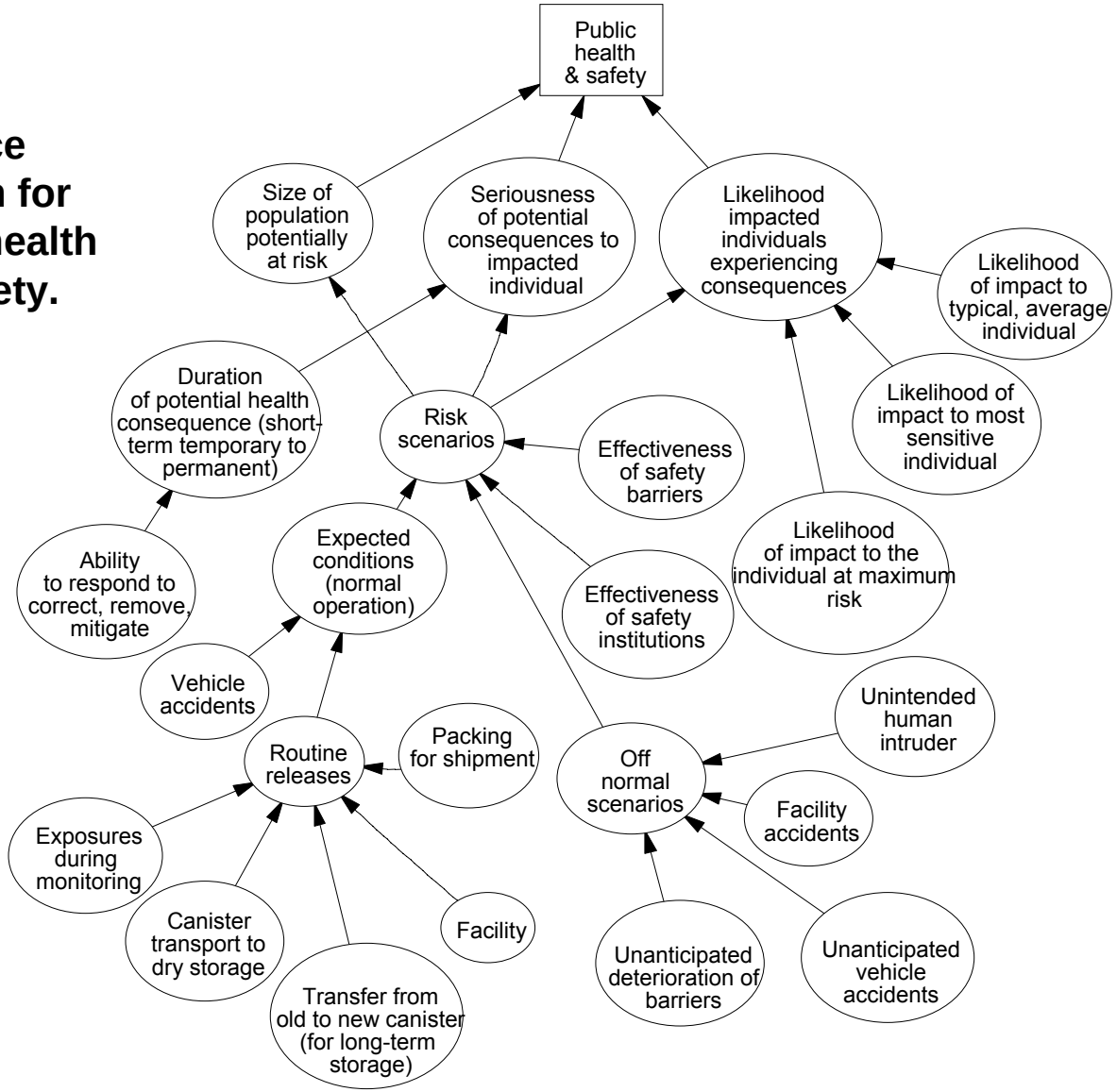
Except for the fairness objective (which considers intergenerational fairness) performance against the objectives was assessed separately for two time frames



Step 2: Identify factors influencing the achievement of objectives

Example:

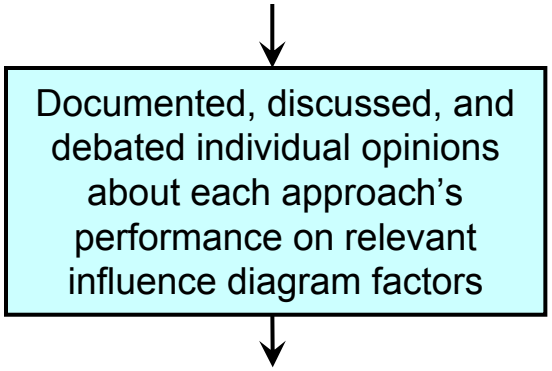
Influence diagram for public health and safety.



The influence diagrams served as "road maps" identifying factors that should be considered when assessing performance against objectives.

Step 3: Estimate how well each approach would perform against each objective

To prepare for the assessments the Team:



Why?

Share knowledge, subject individual opinions to critical review.

A "colour scale" was used to summarize judgments regarding influence diagram factors

Colour Code

Good: Not a significant issue or problem; essentially no impact or effect; about as good as could be expected; in the top 1% of possibilities.

Between "pretty good" and "good".

Pretty good: A small or minimal issue; very low impact or effect; the factor cannot or ought not be ignored, but it is not as important as it is in other contexts or alternatives; it is in the more favorable (25%) range of possibilities.

Between "pretty good" and "middle".

Middle: Important issue; the factor represents a magnitude or level of importance in the middle (50%) of possibilities; although it may raise concerns, the factor is a bigger or more important concern in other alternatives or contexts.

Between "middle" and "poor".

Poor: A concern of relatively high magnitude; within the more adverse (75%) range of possibilities, but not necessarily extreme or unacceptable in and of itself.

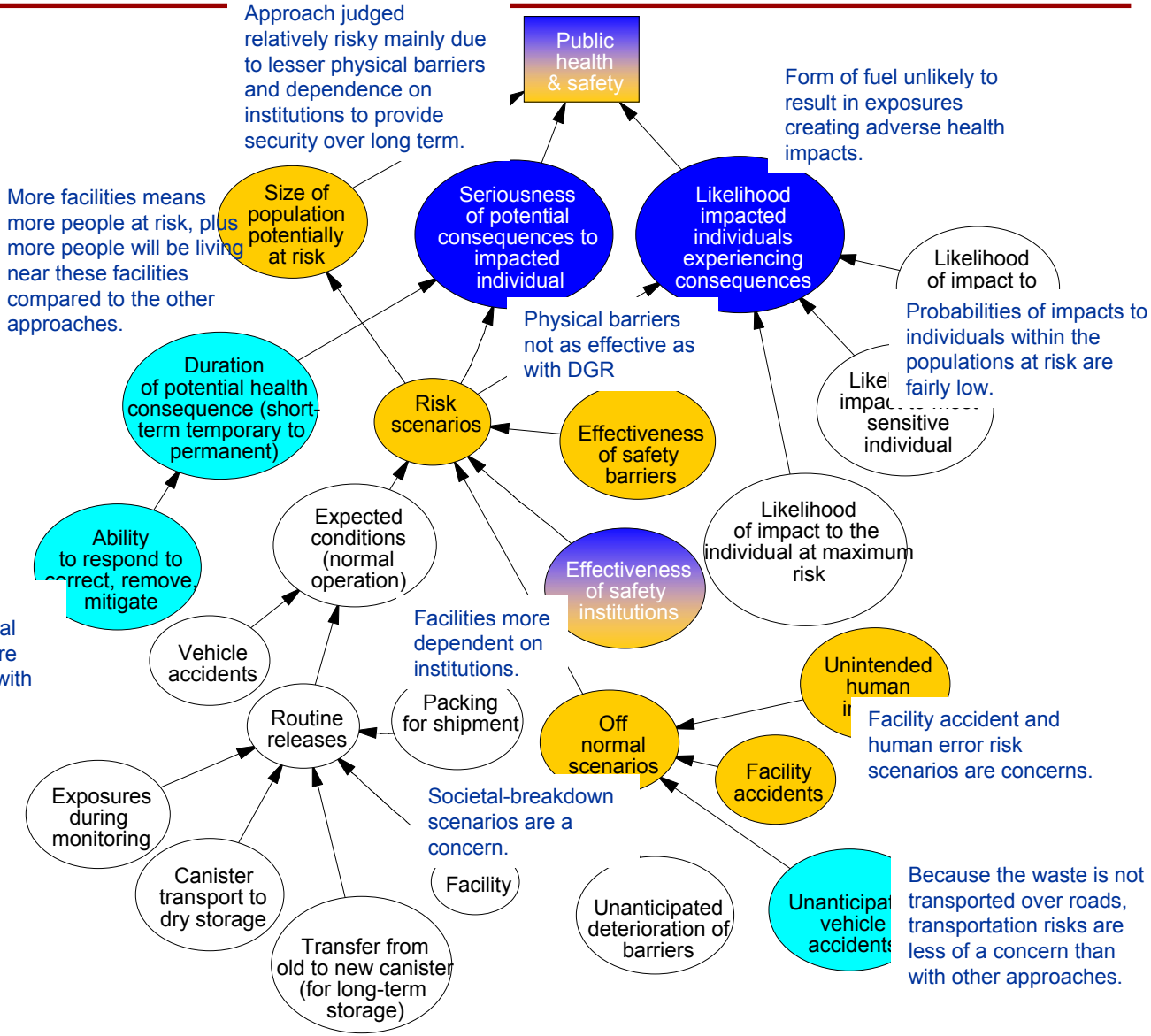
Between "poor" and "very poor".

Very poor: high or among the most extreme (top 99%) of possibilities or alternatives. Deserving of significant attention. Depending on related or interacting considerations, possibly unacceptable.

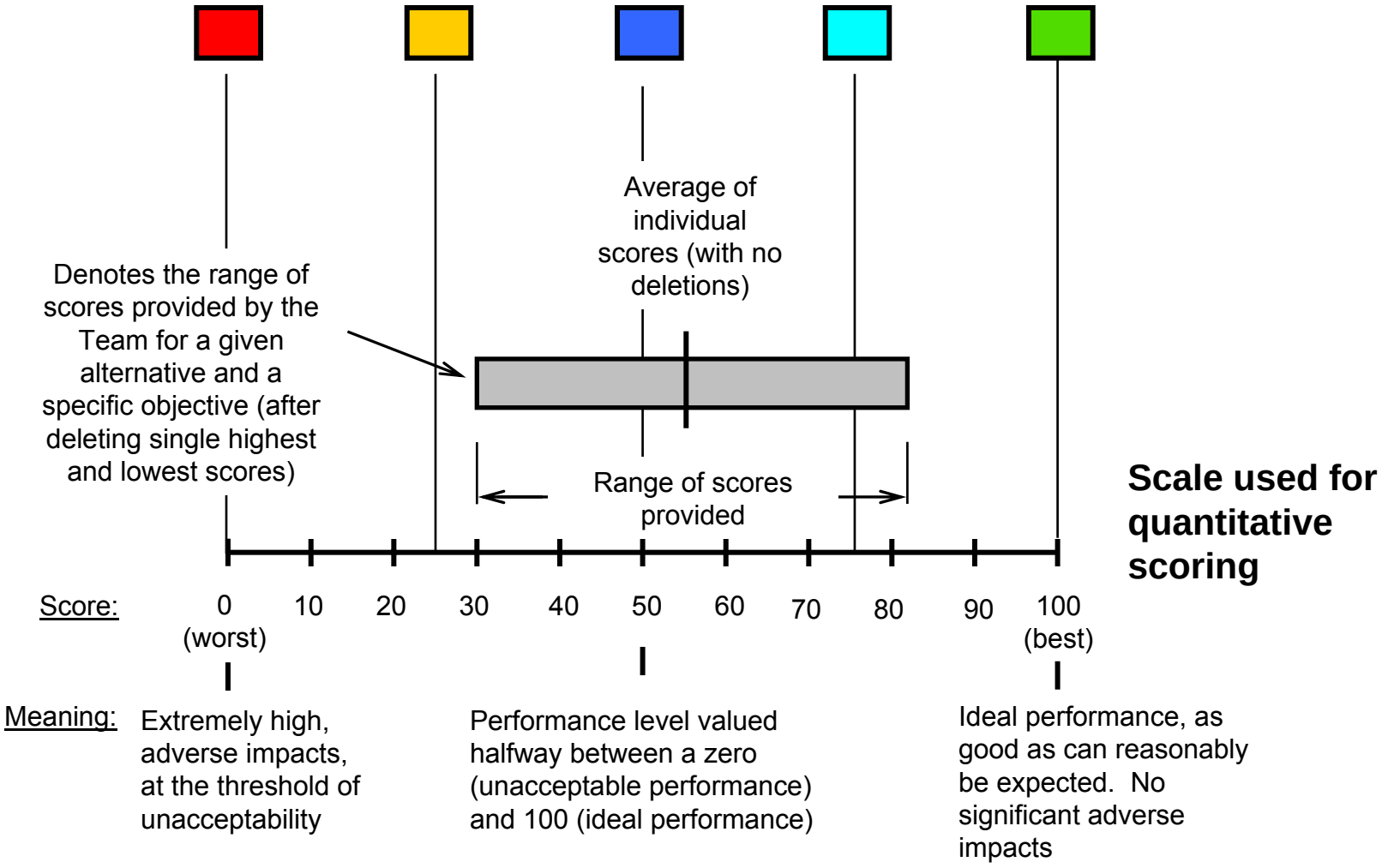
Not a discriminator, not significant, or not formally assessed.

Example of the judgments recorded (On Site Storage, 0-175 years)

- Not a discriminator or not significant
- Good: relative to others
- Pretty good: small concern, better than others
- Middle concern: comparable to others
- Poor: large concern relative to others
- Very poor: very large concern relative to others, potentially unacceptable

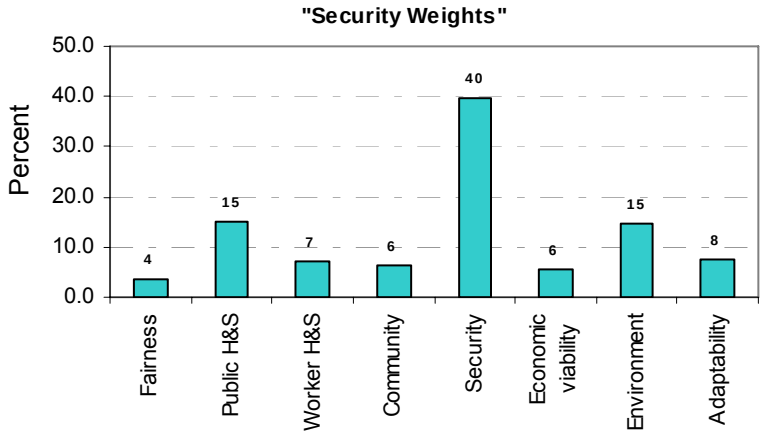


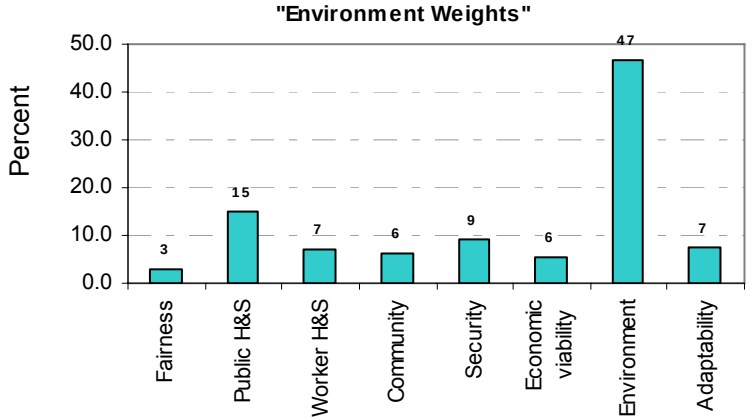
The assigned top-level colours were used to obtain a quantitative scoring ranges for each approach for each objective

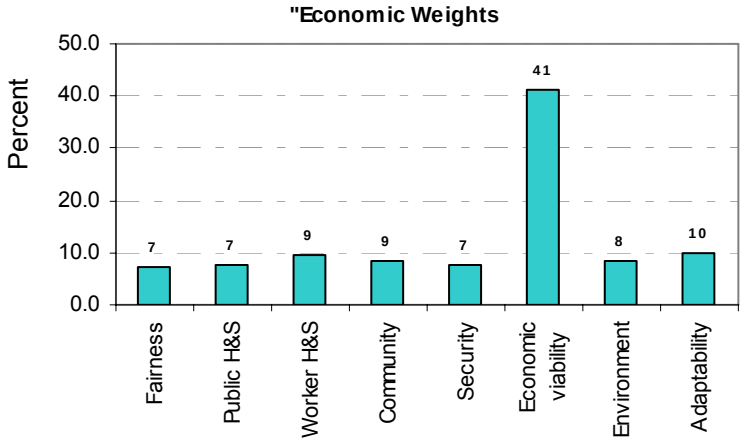


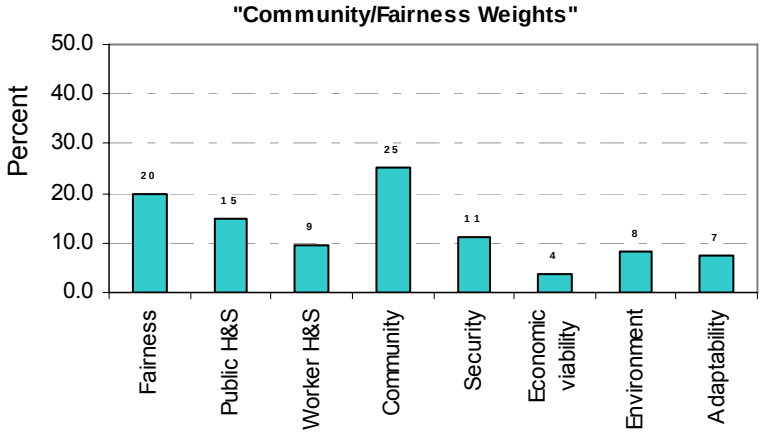
Step 3: Assign weights

Alternative weighting schemes were devised for combining scores into an overall figure of merit for each approach



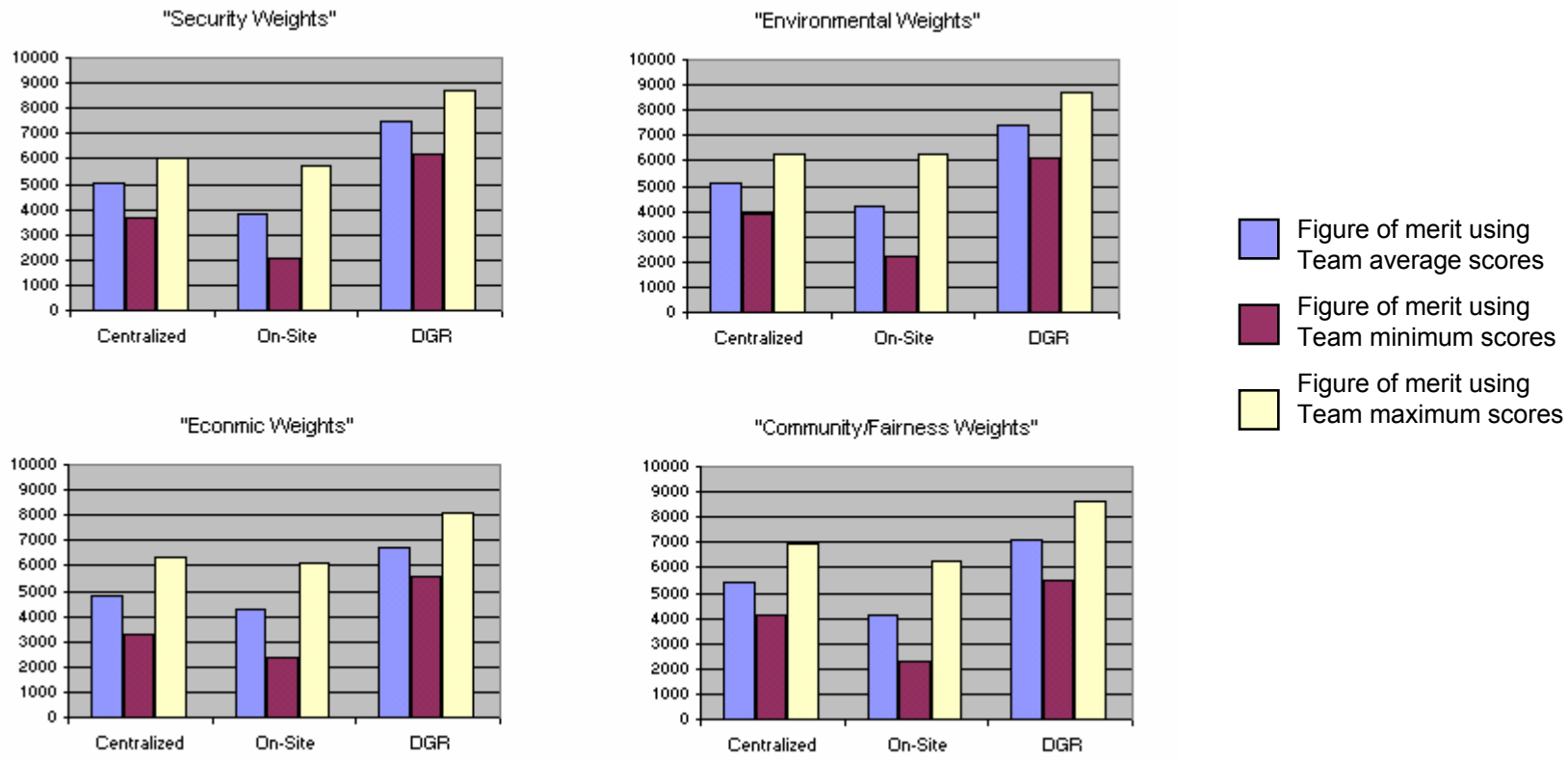






Step 4: Combine performance estimates and weights

DGR was ranked highest regardless of the weighting scheme



In summary,

The Assessment Team believed their assessment would be most useful if they were to:

- **Clearly state what they understood to be the objectives of selecting an approach (objectives hierarchy).**
- **Identify the factors that they believed needed to be considered when judging how well an approach would achieve each objective (influence diagrams).**
- **Document their judgments about well each approach would achieve each objective in terms of what they understood to be relevant factors (summarized in Chapter 6 of "Assessing the Options").**
- **Explore the sensitivity of conclusions to different value judgments about people's willingness to tradeoff achievement of the various objectives (quantitative analysis summarized at the end of Chapter 6).**

The approach gives those who might reasonably disagree the opportunity to point out and focus debate on the specific assumptions made by the Team that are in question.

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2. **Score the alternative management approaches** 
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4. **Compute and review results**

Prior to this meeting, each of you completed "scoring ballots" for each approach.

This included:

- **Identifying, on each influence diagram, factors that discriminate the performance of the approaches. (If you think discriminating factors were left out of the diagrams, you may discuss them when you present your scores)**
- **Writing down (e.g., as a note to each discriminating bubble) reminding you of the logic for the differences you perceive.**
- **Assigning a colour (or range of colours) to the top box on each influence diagram ballot to indicate your overall assessment of the performance of each approach on the corresponding objective.**

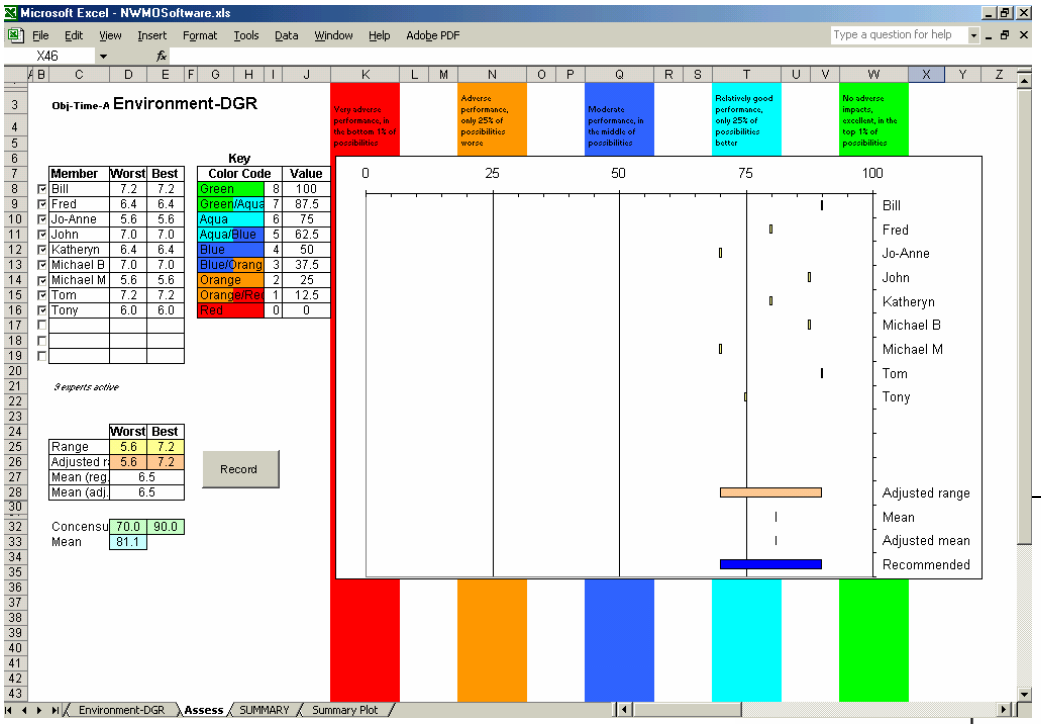
The next step is to discuss and record your individual assessments and generate a group consensus over the range of scores for each alternative and each objective

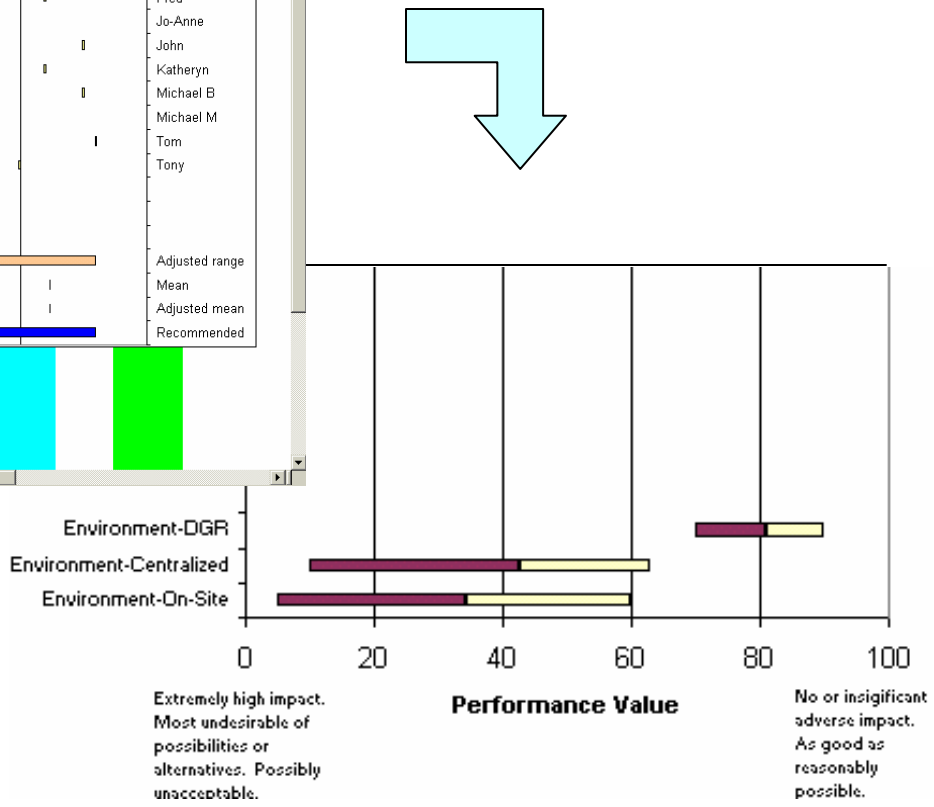
- **One-by-one, each panel member will provides their (top-level) colour assignment and summarize his/her her logic.**
- **If your arguments have already been summarized by someone else, no need to verbalize again. ("My reasoning was basically the same as ___.")**
- **OK at this stage for other participants to ask questions to clarify reasoning ("Tell me again why do you believe DGR will produce severe environmental impacts in the long term?") Discussion is also OK if it appears that any of the essential "rules" for the exercise may not have been followed (e.g., "The factor you are describing is counted under a different objective.")**
- **However, until everyone's initial scores have been recorded, there should be NO DEBATE over those scores.**

The next step is to discuss and record your individual assessments and generate a group consensus over the range of scores for each alternative and each objective

- **After all panel members have provided their top-level colour scores, debate will begin. Those entering the highest and lowest scores will be asked to defend there judgments.**
- **Participants may change there individual scores at any time.**
- **Following debate (stay on time schedule), we will have a final "vote" on the colour assignment scores.**
- **A range and mean score will be computed (single highest and lowest scores will be deleted when computing the range, but not the mean).**
- **If the group can reach consensus over an alternative range, that consensus will be used instead.**

A spreadsheet has been developed to facilitate the recording of scores





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The process for assigning weights requires expressing judgments regarding the relative value of obtaining specified improvements against the various objectives

Individual weight assignment

1. **Decide which specified improvement is "most important".**
2. **Rank the objectives according to the relative value of the specified improvements.**
3. **Poker chip exercise:**
   - **Each participant (individually) assigns weights (100 poker chips).**
   - **Assign the most chips to top ranked objective, etc.**
   - **If you believe achieving the indicated improvement on one objective is twice as valuable as another, assign twice as many chips, etc.)**
   - **Allocate weights from the top down (i. e. if you allocate 10 chips to public health and safety, the sum of the public health and safety weights for the near-term and long-term time periods must equal 10 chips.**

The process for assigning weights consists of 5 steps (continued)

Group weight assignment

4. Comparison of individual weights & discussion
5. Adjustments and consensus weight assignments

Note: The ranking and assignment of weights represent the relative value of obtaining exactly the increment of improvement noted on the ballots. These weights will be re-normalized to reflect the incremental value of the complete scales before they are used in the aggregation equation.

Instructions for Assigning Weights

The goal is to obtain your value judgments about the relative importance of achieving good performance on the various objectives.

Consider the following thought experiment:

Suppose Canada's selected approach to managing used fuel turns out to perform very poorly. Specifically, ASSUME THAT ON EACH OBJECTIVE, THE LEVEL OF PERFORMANCE IS THAT CONSISTENT WITH THE AVERAGE (OR CONSENSUS) SCORE THAT WAS ASSIGNED FOR THE APPROACH THAT DOES WORST ON THAT OBJECTIVE.

> **In other words, assume that Canada had the misfortune of choosing an approach that had the worst features of each of the current alternatives.**

This assumption is the basis for constructing the weighting ballots on the subsequent pages.

1. **If you could improve performance on one objective only, which would you choose? (Mark the objective that you would choose.) We will discuss as a group before moving to next step.**
2. **Rank the objectives based on your judgment of the value of the specified improvements (most valuable improvement to least valuable).**
3. **Distribute poker chips in proportion to the value of the improvement (most chips on top ranked improvement; if you judge one improvement as twice as valuable as another, it should have twice the number of chips.**

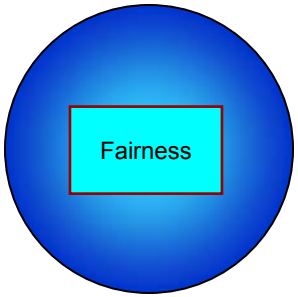
REMEMBER, YOU MUST ASSUME THAT IMPROVING ANY ONE OBJECTIVE CREATES NO IMPROVEMENTS ON ANY OTHER!

Worst performing approach for each objective (according to average scores)

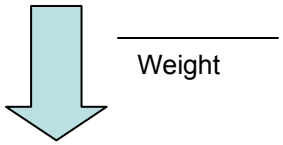
To be provided.

Ballot for Assigning Weights

Name: _____



<u>If left unchanged:</u>
Fairness performance of worst-performing alternative.



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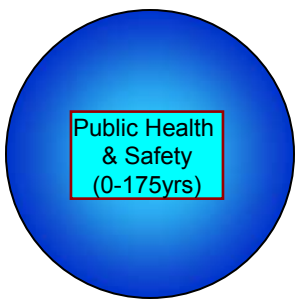
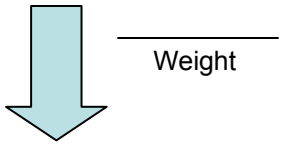
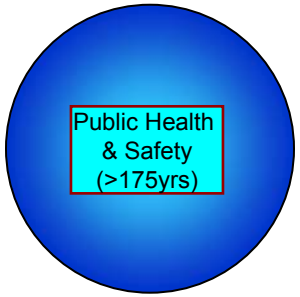
Best possible fairness performance; approach viewed as completely fair. (Scores 100).



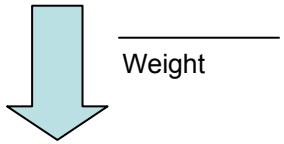
<u>If left unchanged:</u>
Over first 175 yrs, public health & safety performance of worst-performing alternative.



<u>If changed:</u>
Over first 175 yrs, best possible public health & safety performance; essentially no adverse public health & safety impacts. (Scores 100).



<u>If left unchanged:</u>
After first 175 yrs, public health & safety performance of worst-performing alternative.



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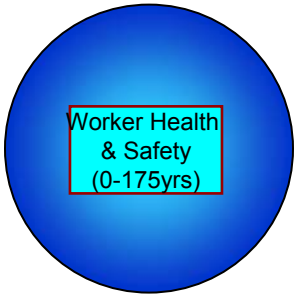

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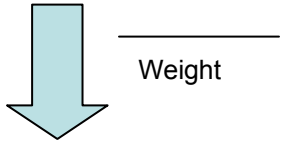
Over first 175 yrs, worker health & safety performance of worst-performing alternative.



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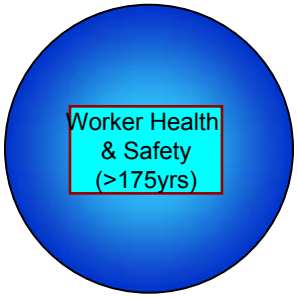

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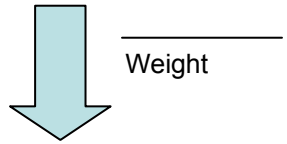
After first 175 yrs, worker health & safety performance of worst-performing alternative.

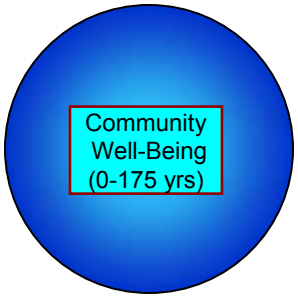


<u>If changed:</u>
After first 175 yrs, best possible worker health & safety performance; essentially no adverse worker health & safety impacts. (Scores 100).

Remember, <u>assume improving any one objective creates no benefit on any other.</u>

Ballot for Assigning Current Generation Weights (Continued)

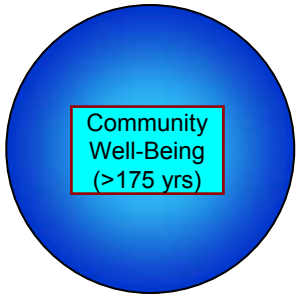
Name: _____



If left unchanged:
Over first 175 yrs, community well-being performance of worst-performing alternative.

Weight _____

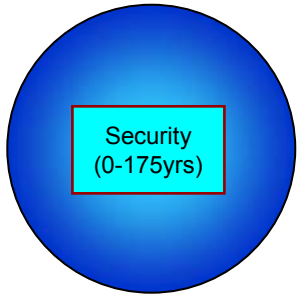
If changed:
Over first 175 yrs, best possible community well-being performance; essentially no adverse impacts on communities. (Scores 100).



If left unchanged:
After first 175 yrs, community well-being performance of worst-performing alternative.

Weight _____

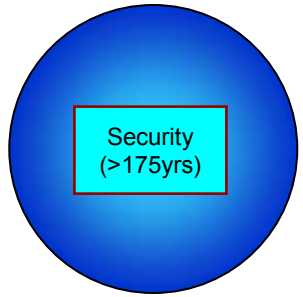
If changed:
After 175 yrs, best possible community well-being performance; essentially no adverse impacts on communities. (Scores 100).



If left unchanged:
Over first 175 yrs, security of worst-performing alternative.

Weight _____

If changed:
Over first 175 yrs, best possible security; no security breaches. (Scores 100).



If left unchanged:
After first 175 yrs, security of worst-performing alternative.

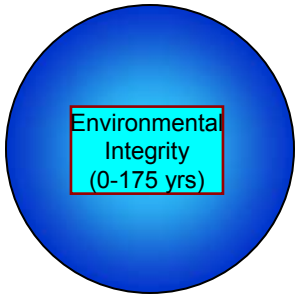
Weight _____

If changed:
After 175 yrs, best possible security; no security breaches. (Scores 100).

Remember, <u>assume improving any one objective creates no benefit on any other.</u>

Ballot for Assigning Current Generation Weights (Continued)

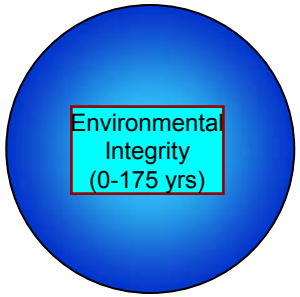
Name: _____



<u>If left unchanged:</u>
Over first 175 years, environmental performance of worst-performing alternative.

Weight _____

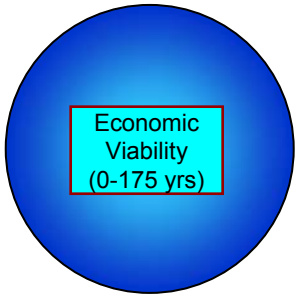
<u>If changed:</u>
Best possible environmental performance; essentially no adverse environmental impacts. (Scores 100).



<u>If left unchanged:</u>
Over first 175 years, environmental performance of worst-performing alternative.

Weight _____

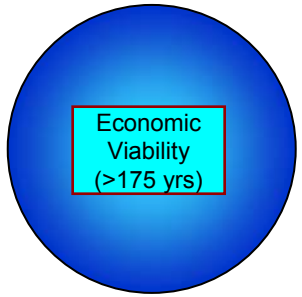
<u>If changed:</u>
Best possible environmental performance; essentially no adverse environmental impacts. (Scores 100).



<u>If left unchanged:</u>
Over first 175 yrs, economic performance of worst-performing alternative.

Weight _____

<u>If changed:</u>
Over first 175 yrs, best possible economic performance; favorable costs and ample resources to pay those costs. (Scores 100).



<u>If left unchanged:</u>
After first 175 yrs, economic performance of worst-performing alternative.

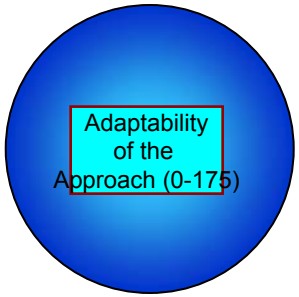
Weight _____

<u>If changed:</u>
After first 175 yrs, best possible economic performance; favorable costs and ample resources to pay those costs. (Scores 100).

Remember, <u>assume improving any one objective creates no benefit on any other.</u>

Ballot for Assigning Current Generation Weights (Continued)

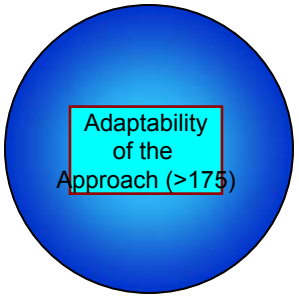
Name: _____



<u>If left unchanged:</u>
Over first 175 yrs, adaptability of worst-performing alternative.

_____ Weight

<u>If changed:</u>
Best possible adaptability; flexible; capable institutions and governance; transparent, accountable. (Scores 100).



<u>If left unchanged:</u>
After first 175 yrs, adaptability of worst-performing alternative.

_____ Weight

<u>If changed:</u>
Best possible adaptability; flexible; capable institutions and governance; transparent, accountable. (Scores 100).

Remember, <u>assume improving any one objective creates no benefit on any other.</u>