

# ENTRIA

DISPOSAL OPTIONS FOR RADIOACTIVE RESIDUES:  
INTERDISCIPLINARY ANALYSES AND  
DEVELOPMENT OF EVALUATION PRINCIPLES

## Interdisciplinary Perspectives on Dose Limits in Radioactive Waste Management

A Research Paper Developed within the ENTRIA Project

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## Outline

- I. The ENTRIA Project
- II. (Dose) limits and societal debates about health effects of ionizing radiation
- III. (Dose) limits and nuclear waste governance: The example of post-closure safety of deep repositories for radioactive waste

## I. ENTRIA

- ENTRIA Partners: 12 departments from German universities and major research institutions and one partner from Switzerland

- Disciplines represented

- Natural sciences
- Civil engineering
- Repository research
- Philosophy
- Law
- Social sciences
- Political sciences
- Technology assessment



- Project structure designed to foster interdisciplinarity



## Objectives and Fields of Work

- Disciplinary and interdisciplinary research regarding three waste management options
  - Final disposal in deep geological formations without arrangements for retrieval
  - Emplacement in deep geological formations with arrangements for monitoring and retrievability
  - Prolonged surface (or near-surface) storage
  
- Disciplinary and cross-disciplinary education



## The ENTRIA Working Paper on Dose Limits

- Based on recognitions that ...
  - Dose limits are of utmost importance when addressing both technical and governance aspects
  - Joint work on specific and pinpointed projects and topics is a major driver of interdisciplinary collaboration
  
- Interdisciplinary synthesis: 14 propositions on the following themes:
  - Perceptions concerning effects of radiation
  - Genesis of such limits
  - Perception of (dose and other) limits (reference values, constraints, ...)
  - Problems of the (dose and other) limits concept

## This presentation ...

- ... will focus on those areas that the presenters are most familiar with, i.e.
  - Societal debates about health effects of ionizing radiation
  - Post-closure safety of deep (geologic) disposal facilities for radioactive waste
- ... will, by such means, present selected propositions of the Working Paper (which is still a work in progress)
- ... will, therefore, NOT be able to cover the whole scope of the paper



## II. Limits – the bigger societal picture

**Limits fulfill different tasks in different societal systems:**

engineers

- guideline for developments

public authorities

- basis for decision-making about licensing

public

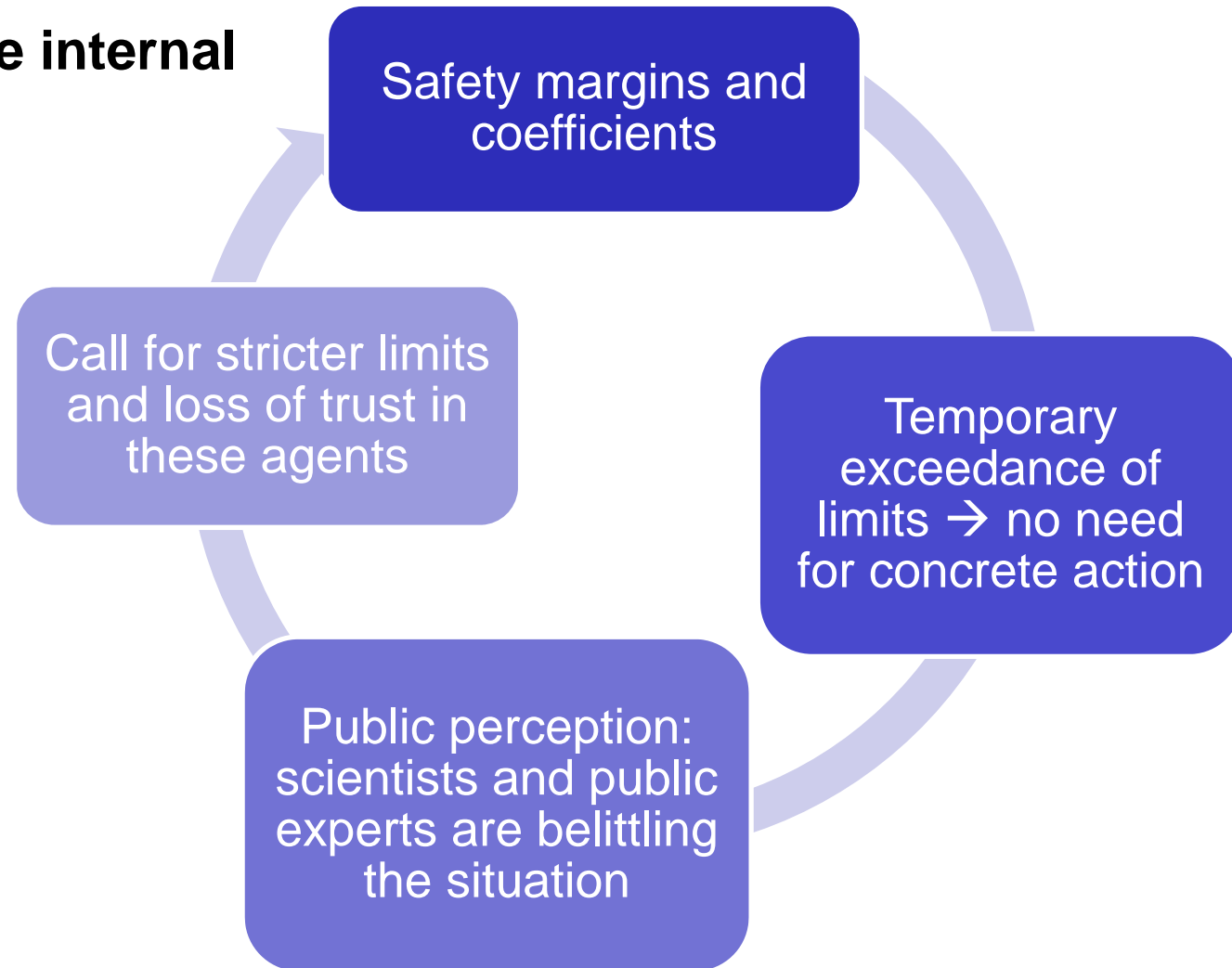
- indicator for threats

media

- (in case of exceeding limits) news value



**Problem of the internal logic of the limit system:**





## **(Dose) limits and societal debates about health effects of ionizing radiation**

- A loss of trust already occurred in many countries in relation to the nuclear complex
- (Dose) limits – and in particular the exceedance of (dose) limits – have become a central point of attention, as the complexity of the entire nuclear issue is reduced here to a simple number
- Thus, the debate about dose limits is often not a debate about a specific numerical (dose) limit, but represents the debate about the national (or even international) nuclear techno-political regime as such



## ENTRIA propositions:

- The use of dose limits in the frame of regulatory systems is being put into question both with regard to scientific and governance questions
- The strategy of addressing this loss in trust with concepts like „better educating the public about risk“ did not increase trust in the system, as the initiators of these campaigns were not considered trustworthy.
- As ionizing radiation is broadly considered a health threat without any threshold, there is a strong societal demand for zero-emissions of nuclear facilities. This demand also holds for facilities for deep geological waste disposal.

(These propositions focus on the situation in Germany)

cf. Tanja's introductory EAGLE presentation



### **III. (Dose) limits and nuclear waste governance: The example of post-closure safety of deep repositories for radioactive waste**

- What are the specific implications for nuclear waste management, in particular with regard to deep geological disposal?
- In this respect, these conflicts are not only negotiated for the here and now, but for timescales and planning processes that reach far into the future

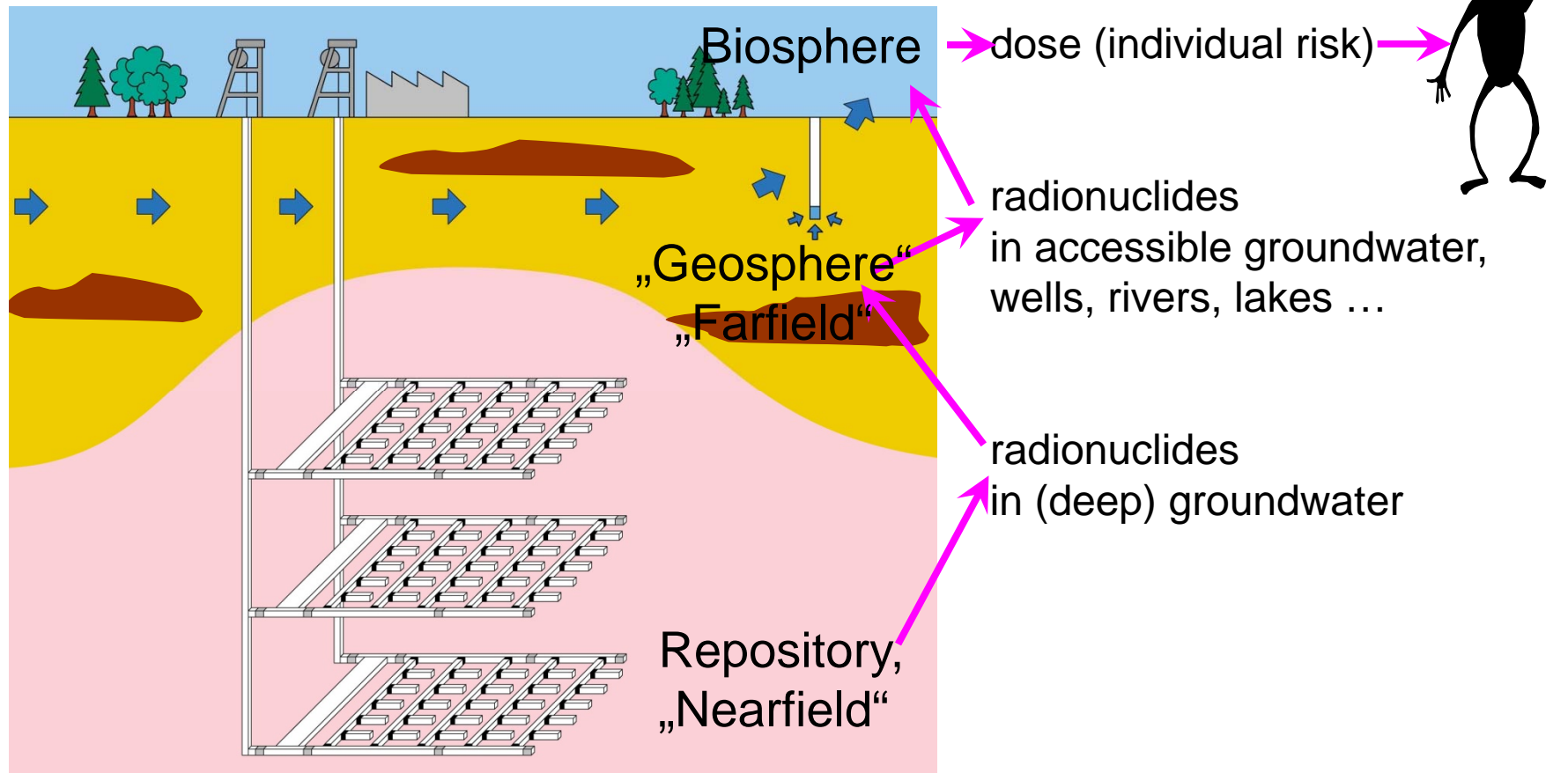


## Criteria for long-term safety of deep repositories

- The intent is „passive safety“ – in other words: „protection“ in the usual (active) sense cannot be relied on
- The guiding principle: Exposure of future generations must not exceed what is accepted today
  
- Note, however:
  - Compliance timeframes of up to 1 Mio years
  - Compliance with numerical criteria can only be demonstrated by ...
    - developing and postulating scenarios (potential future system evolutions)
    - performing assessment calculations for these scenarios using numerical models



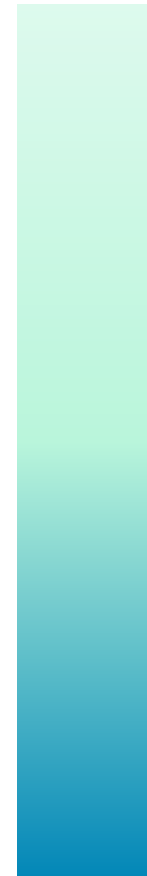
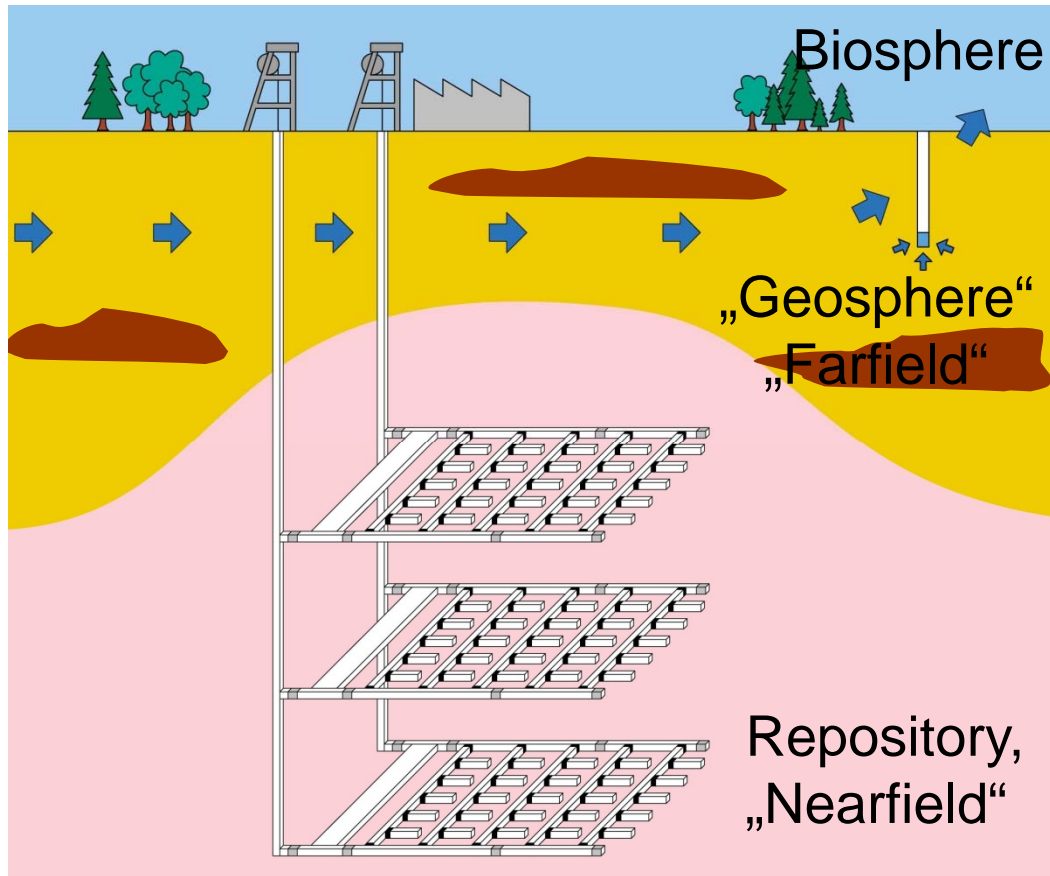
# Integrated modelling: results





# However: Loss of predictability with time ...

Reasonable predictability for ...

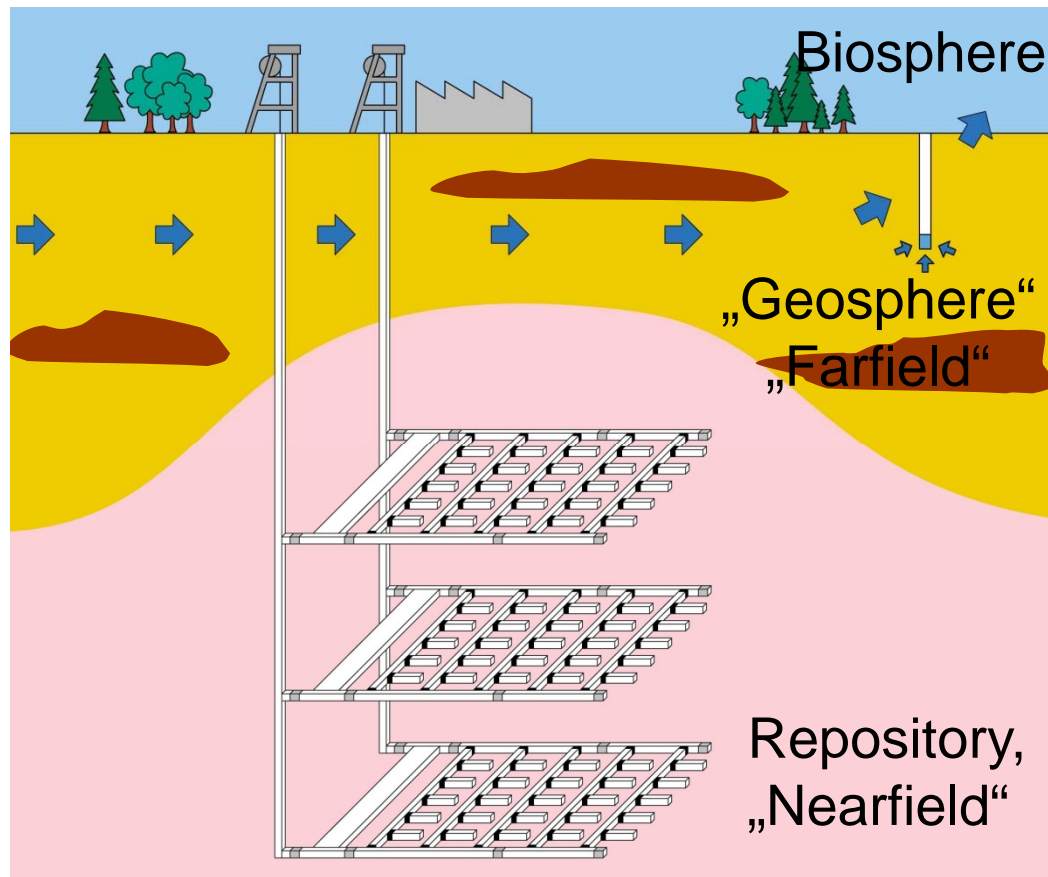


some years

several 100.000 yrs



## Roles of system components



➤ „Protected good“

➤ Major contributors to confinement and, thus to protection



## From ICRP 122 / 103

- “In the very long term, dose and risk criteria should be used for the comparison of options rather than a means of assessing health detriment.”
- “... dose estimates should not be regarded as measures of health detriment beyond times of around several hundreds of years ... represent indicators of the protection afforded by the disposal system”

## Different perceptions of numerical indicators

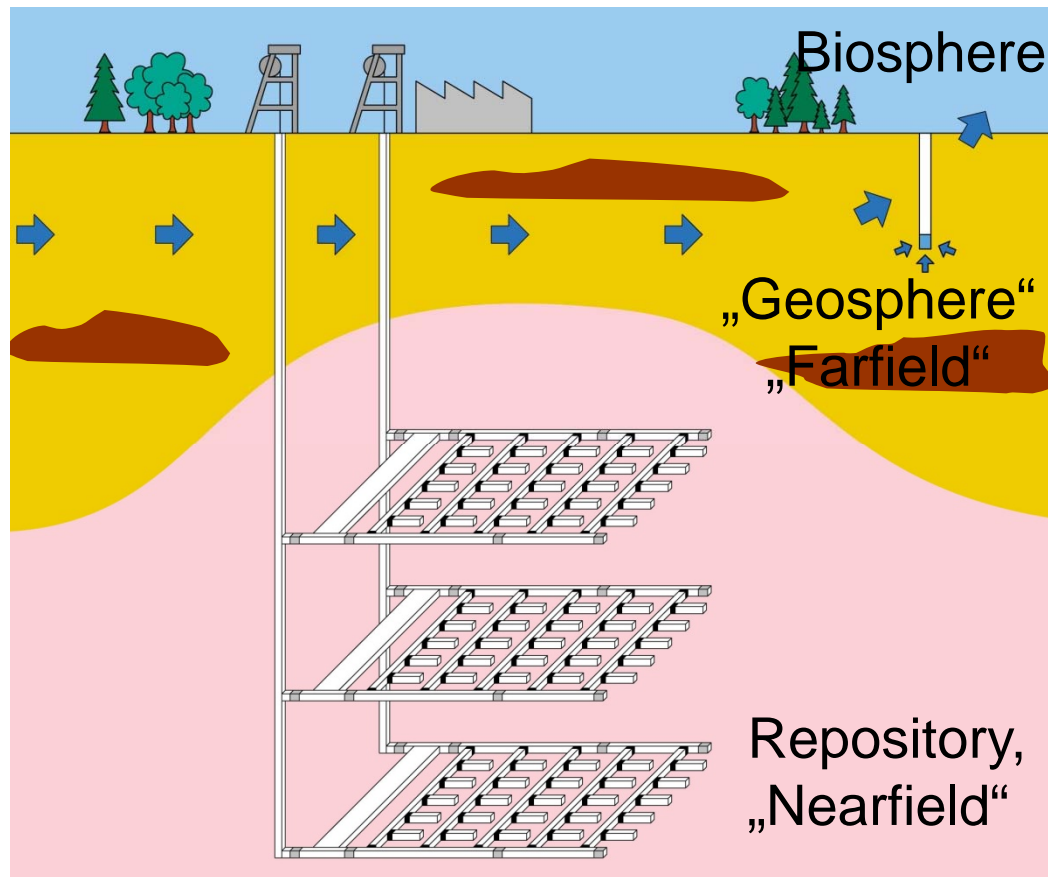
- *For specialists:*
  - One piece of the compilation of evidence
  - Associated with (sometimes considerable) uncertainties
  - To be understood in context of assumptions, scenarios, ...
    - to be taken with a „grain of salt“
  - HOWEVER: still indispensable  
(regulatory compliance, optimization)!
  
- *For others:*
  - Perhaps THE safety information? Discussion with mass media, politicians etc. tend to focus on numerical criteria
  - Example: see Hocke & Röhlig 2013



## ENTRIA propositions:

- (Dose) limits are the result of scientific, societal and political negotiations and stipulations. They are based on knowledge, perceptions and interests.
  - (Dose) limits do not stand alone but are woven into various sets of regulations. However, different actors perceive and judge the relevance of these contexts most differently.
  - Classical concepts of (dose) limits are not helpful when addressing societal controversies about radioactive waste management.
- Thus: What are we looking for?
  - Given that limits et al. are indispensable for specialists, are we looking for ...
    - supplements?
    - alternative ways of communication?
    - something else?

## Roles of system components



- Major contributors to confinement and, thus to protection



**Thank you for your attention!**

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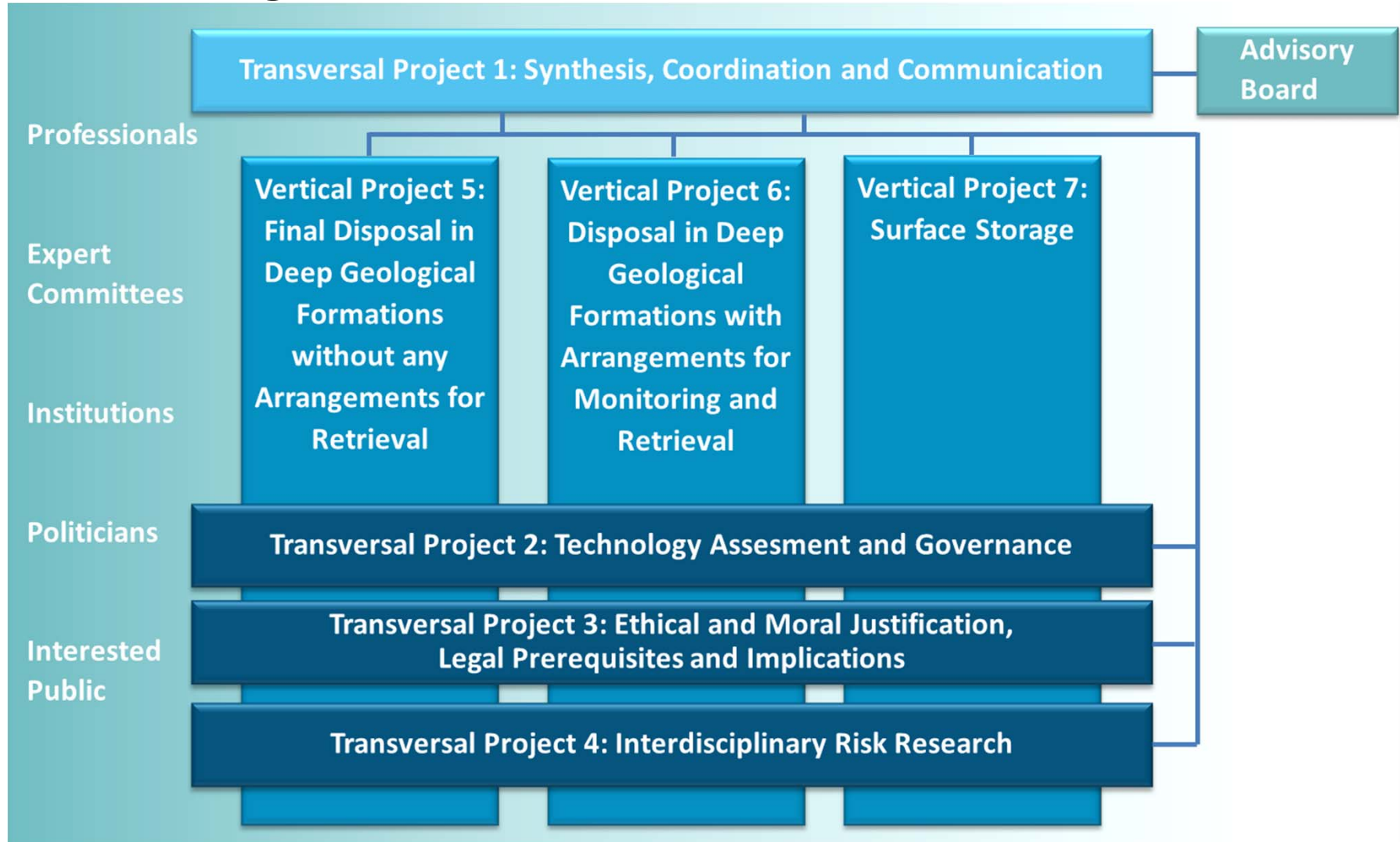
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## Backup slides



# ENTRIA: Organizational Structure





## By the way: Please note ...

... that disposal specialists use the word „optimisation“ NOT in exactly the same way radiation protection specialists do:

- chosen option is not necessarily the one associated with the lowest dose ... from optimisation of radiological protection to system optimisation
- ... the normal process of stepwise development of a repository from a conceptual basis to its implementation ... is by itself a sufficient process of optimisation
- Other factors than radiological protection will be typically taken into account ... quality of the design and its conception, such as predictability, demonstrability, feasibility of construction, flexibility of operation, maintenance and retrievability. Factors of more societal nature will include availability of transport routes, public acceptance and cost.

<http://www.oecd-nea.org/rwm/reports/2010/nea6836-optimisation-ENG.pdf>



## The broader perspective: Safety case

- Safety Case: “a formal compilation of evidence, analyses and arguments that quantify and substantiate a claim that the repository will be safe” (OECD/NEA 2013)
- Calculation / modelling ...
  - produces a broad variety of results (“**indicators**”): from *annual individual effective dose* to *container lifetime*, some being amenable to comparison with regulatory criteria for compliance check
  - is, however, just one (though central) line of evidence in a Safety Case, others being, inter alia,
    - Geosynthesis
    - Engineering arguments concerning suitability of the design, construction and operation
    - Research results
    - Administrative and managerial arguments

## Example: German Safety Requirements (2010) ...

- ... address Safety Case aspects in a holistic way
- ... carry several innovative elements,
- HOWEVER: media coverage and political negotiation focused very much on criteria for indicators such as dose, risk, collective dose
- (Note that the Safety Requirements spend only 2 of its 22 pages on this issue)

Hocke & Röhlig 2013