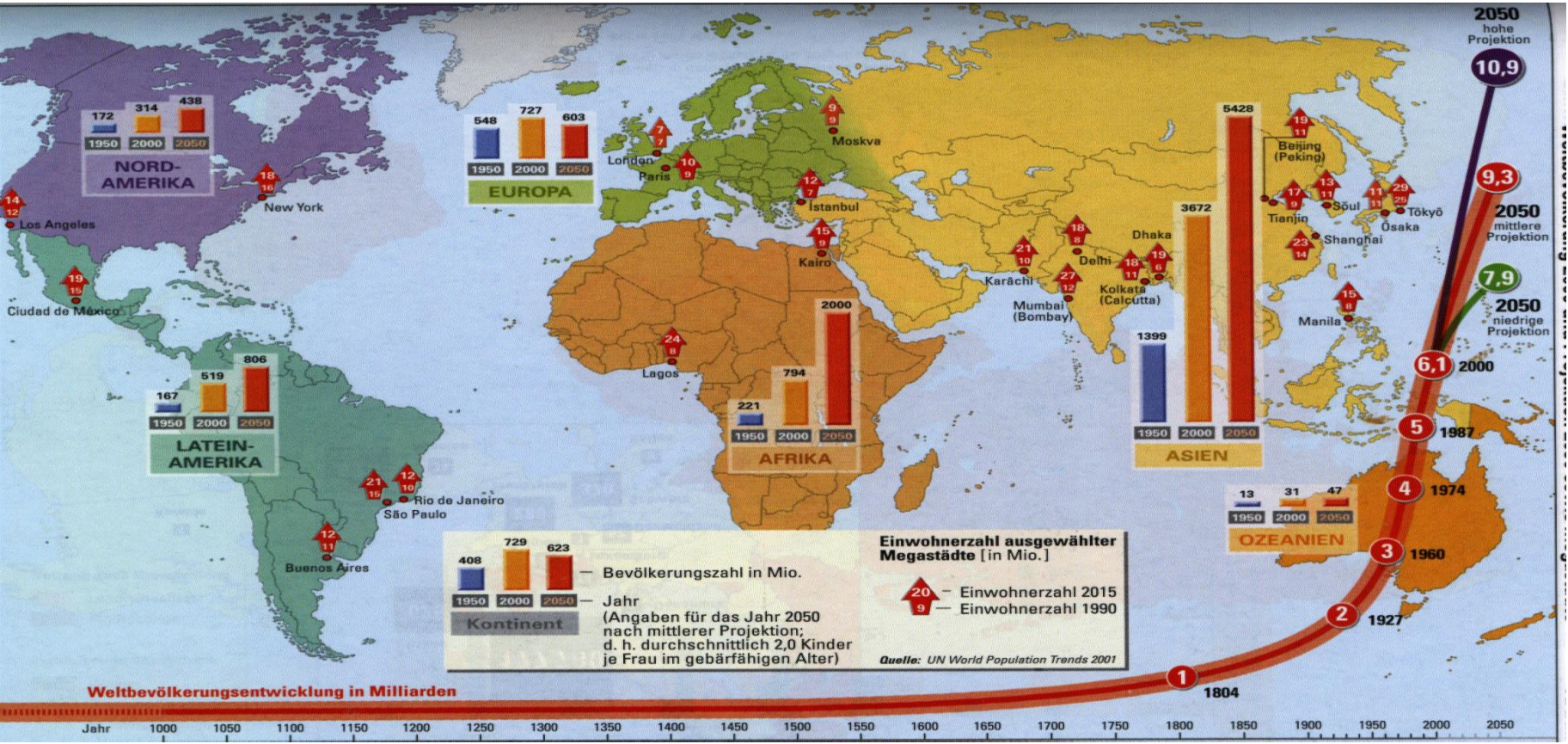


Radioactive waste in Germany – current situation and future perspectives



CASTOR®-Behälter – Beispiel eines Spezialbehälters für den Transport und die Lagerung von radioaktiven Stoffen im Transportbehälterlager Gorleben

Clemens Walther
Institut für Radioökologie und Strahlenschutz
Leibniz Universität Hannover



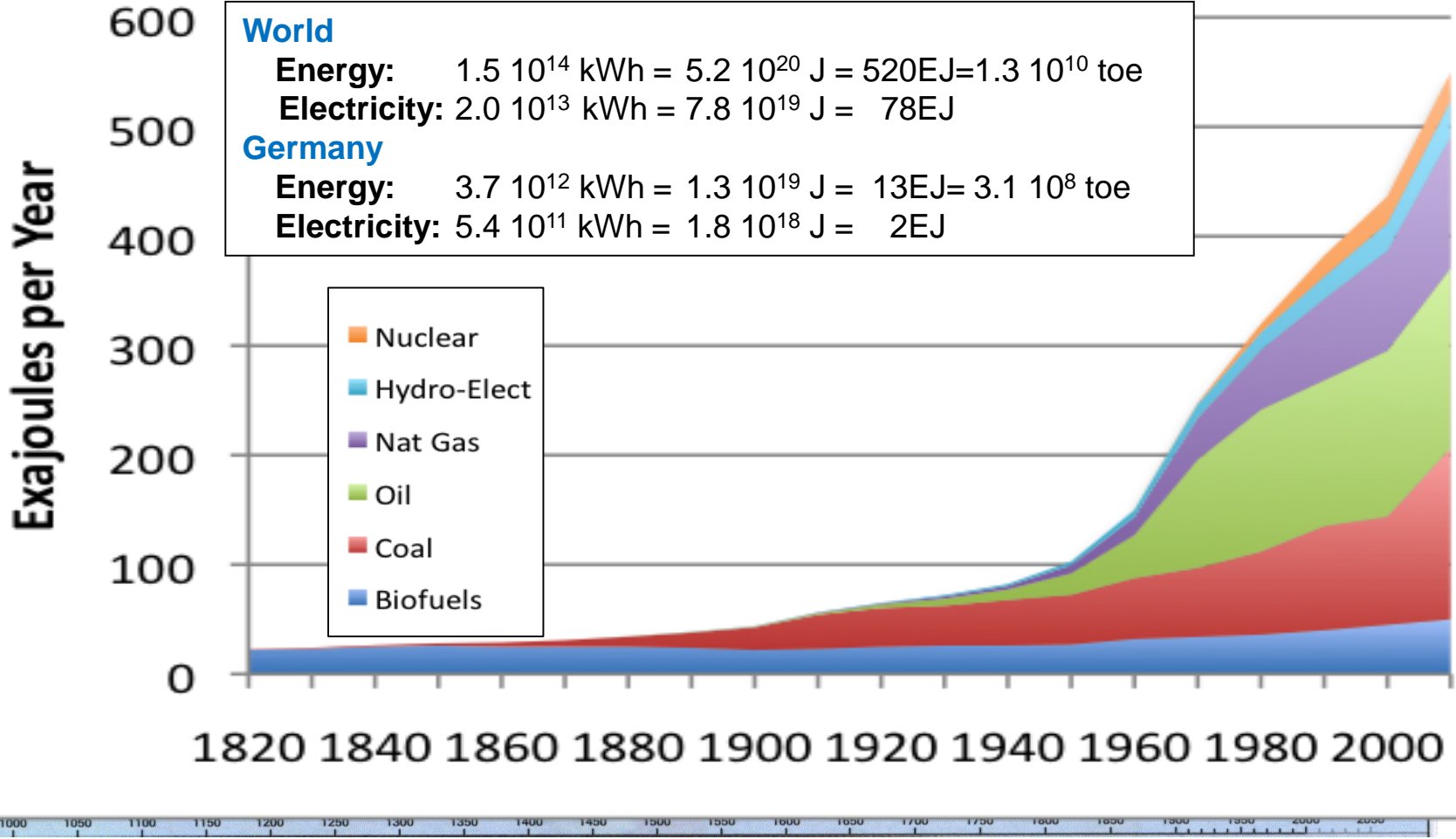
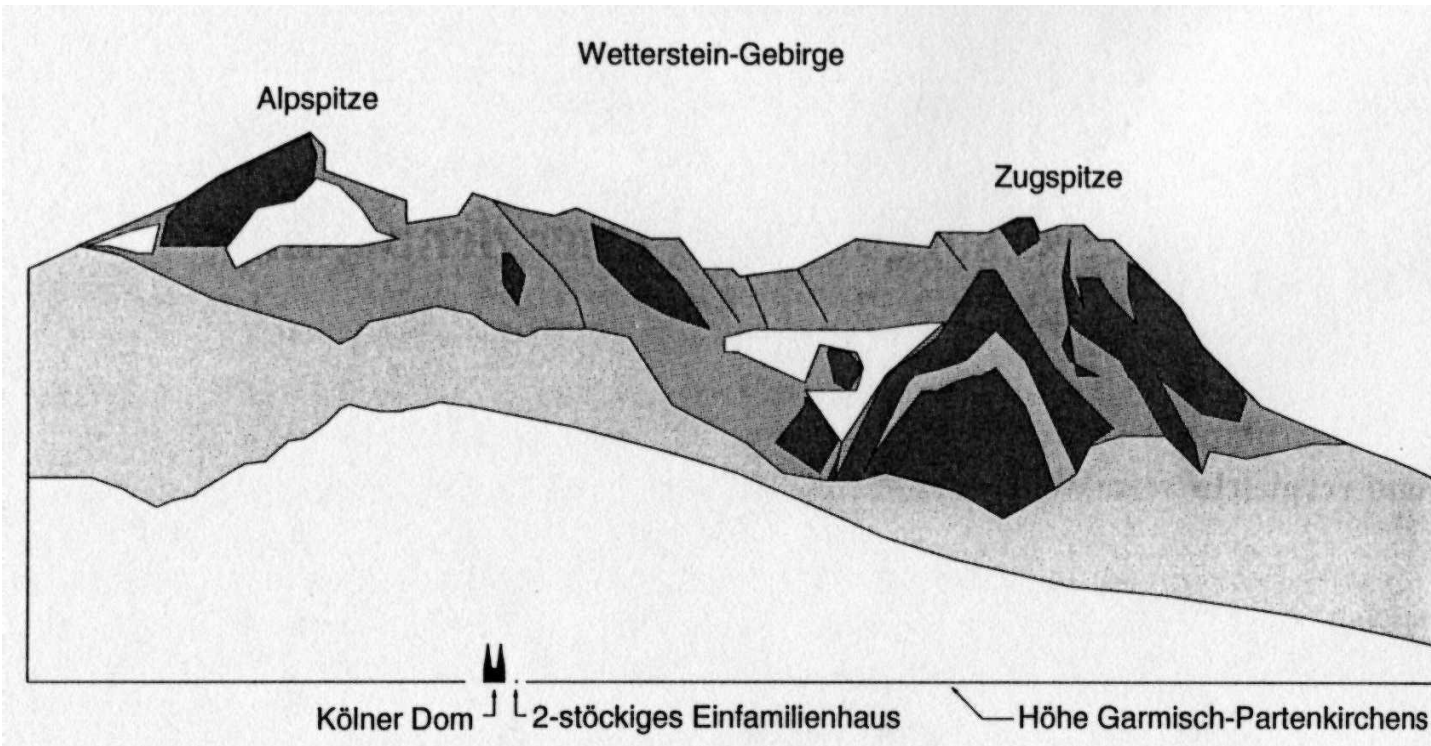
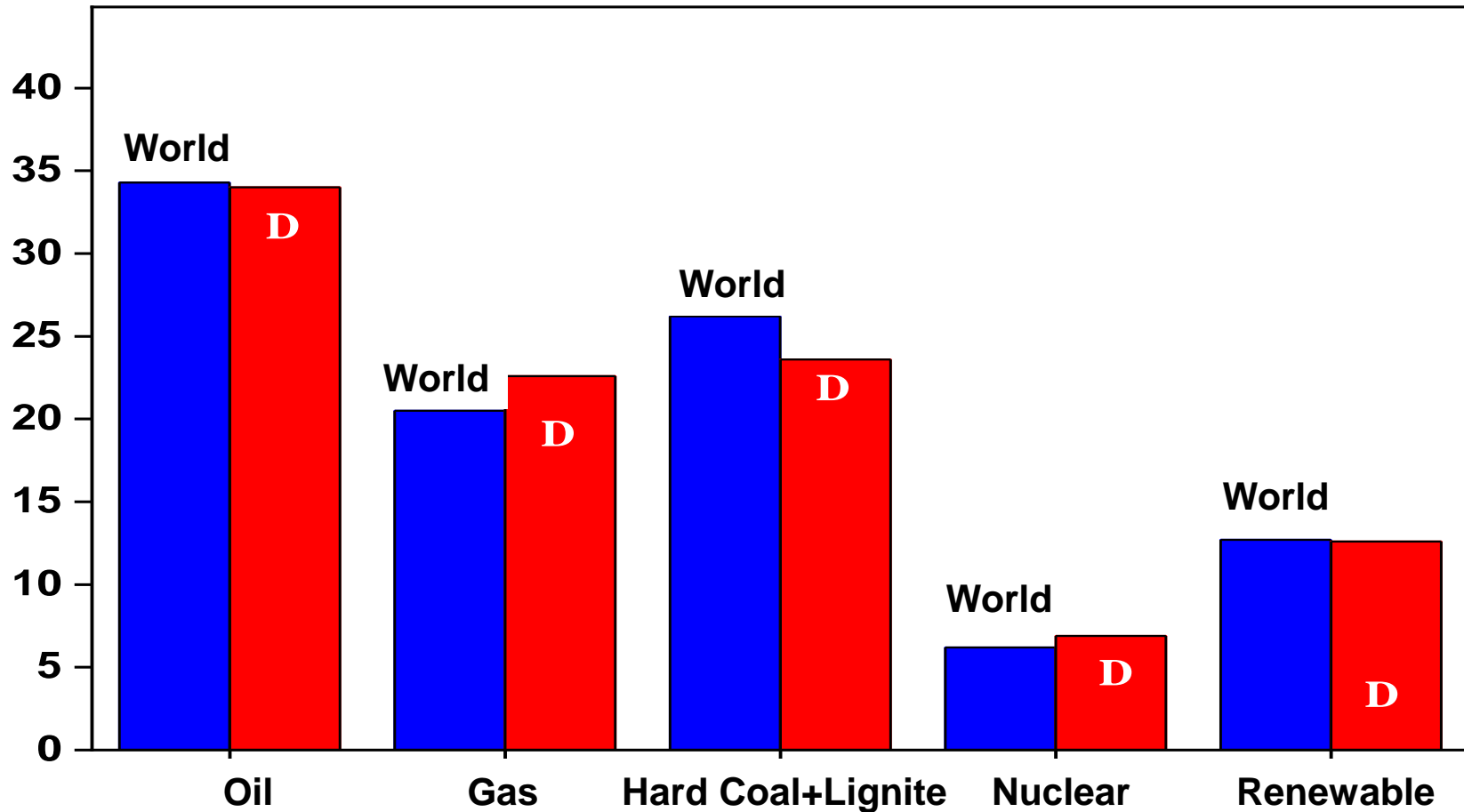


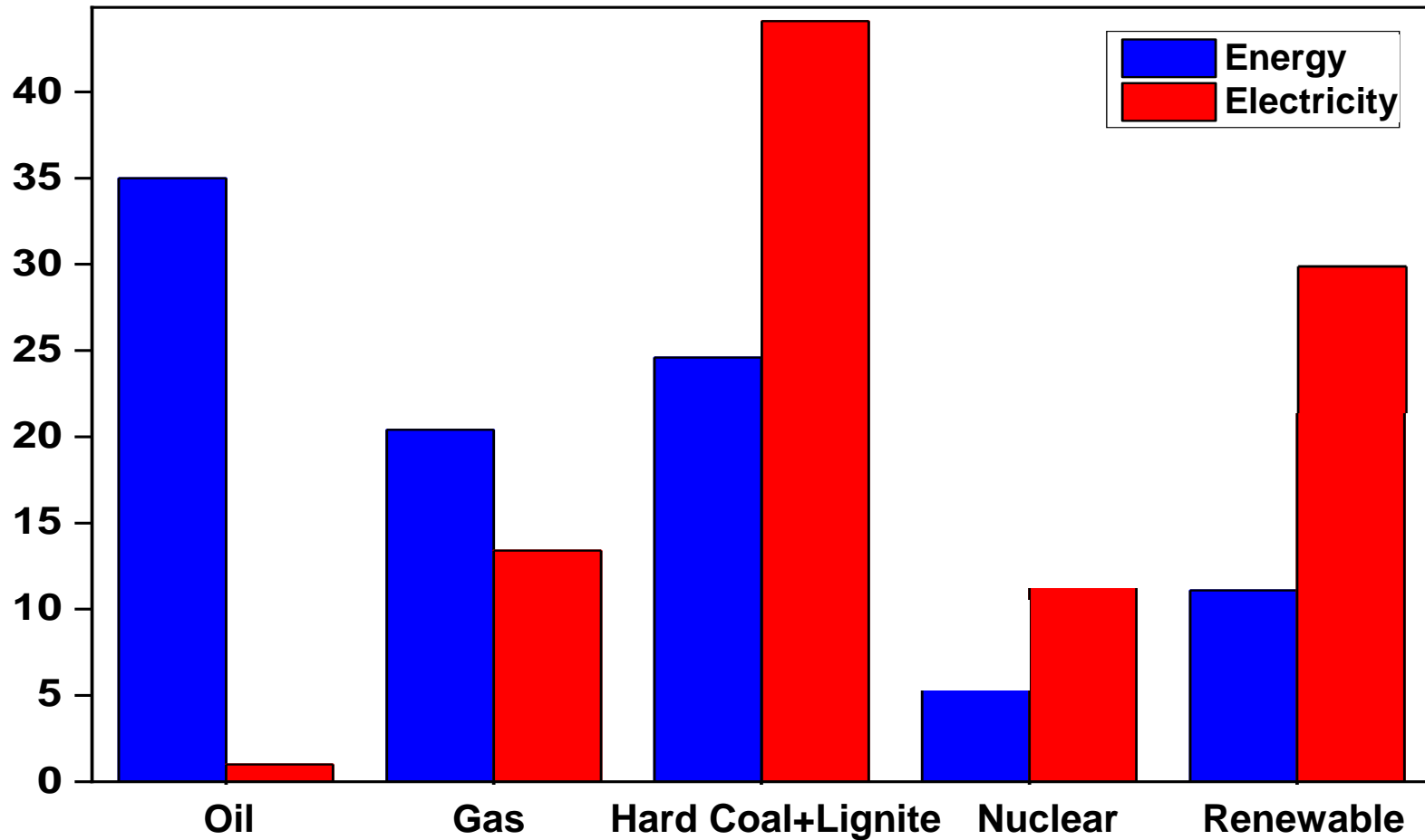
Table: Values for energy from BP Statistical Review of World Energy 2015
 Values for electricity from <http://www.eia.gov/> abg. 9.10.15

If the total world energy demand was covered by coal ...





Daten aus <http://www.umweltbundesamt.de> 13.10.2018



Daten aus <http://www.bmwi.de/> 13.10.2018



Kernkraftwerk

A Kernbrennstoffversorgung **B** Wiederaufarbeitungsanlage

In Betrieb **Außer Betrieb** genommen gemäß Atomgesetz-Novelle (ATG) von 2011 **Stilllegung**

C Zwischenlager **D** Konditionierung **E** Endlager

Rückbau **„Grüne Wiese“** **In Planung**

KKW in Betrieb NPP in operation	Leistung brutto Rated capacity gross (MWe)	Betriebsbeginn (kommerziell) Start of commercial operation
Brokdorf	1.480	1986
Emsland	1.406	1988
Grohnde	1.430	1985
Gundremmingen C	1.344	1985
Isar 2	1.485	1988
Neckarwestheim II	1.400	1989
Philippsburg 2	1.468	1985
Gesamt Total	10.013	

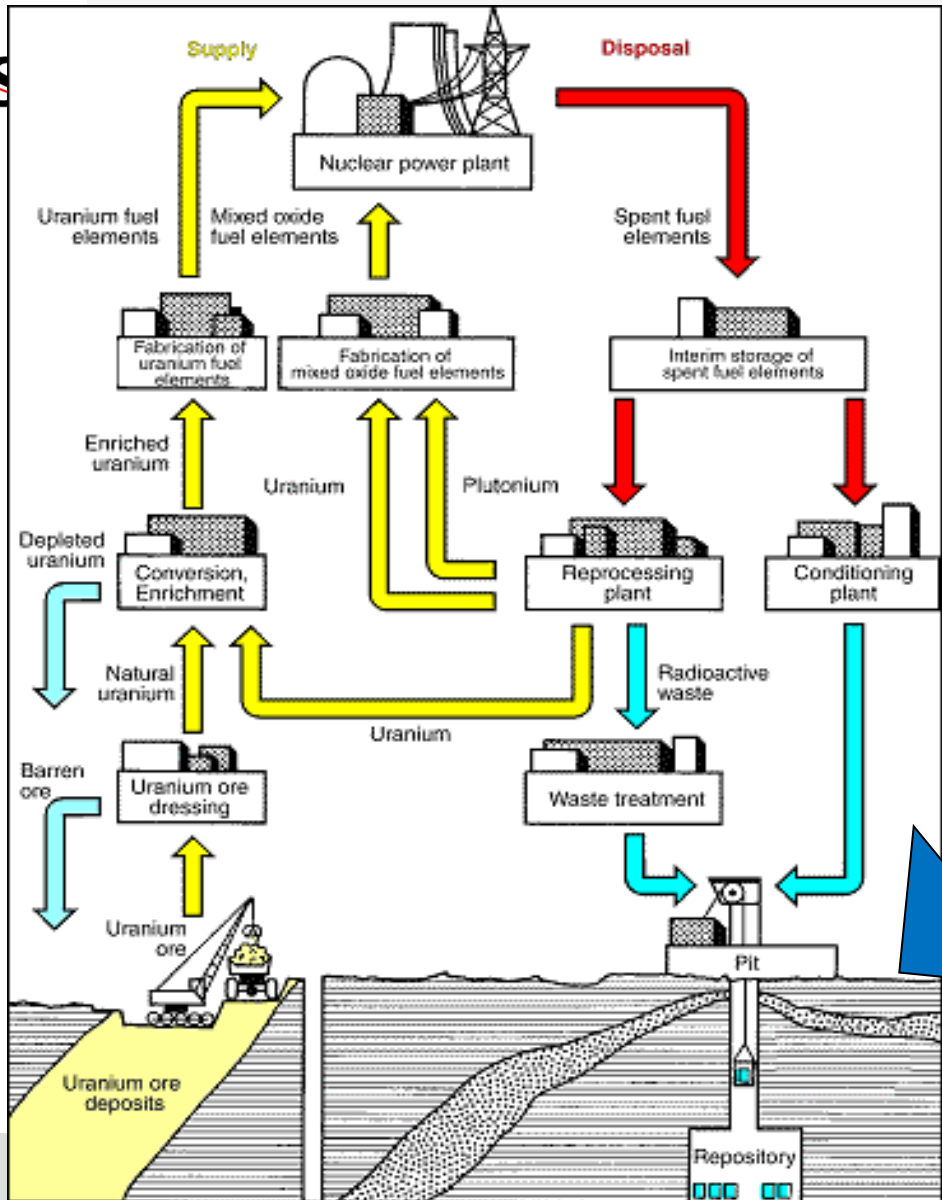
- **2000**: 19 reactors (light water PWR and BWR),
170·10⁹ kWh – 29 % of total (gross) electricity production
- 1. **2000**: agreement between Federal Government and utility companies:
 - Total residual electricity amount to be produced by 19 nuclear power plants:
2,623.30·10⁹ kWh (net)
 - **Operating life time 32 years per nuclear power plant** (average)
- 2. **2010**: “phase-out from the phase-out”:
 - Residual electricity amount increased; lifetime extensions of 8-14 years per reactor
 - Nuclear as “bridging technology” **when moving towards renewables and meeting CO₂ emission targets at the same time**
- 3. **2011**: Tōhoku earthquake, resulting tsunami und Fukushima accidents →
 - Residual electricity amount decreased (back to amounts defined in 2000). License expiry for 8 blocks by August 6, 2011
 - Later license expiries for remaining 9 blocks, for the **last 3 by 2022**
- **2012**: 9 reactors, 99·10⁹ kWh – 16 % of total (gross) electricity production

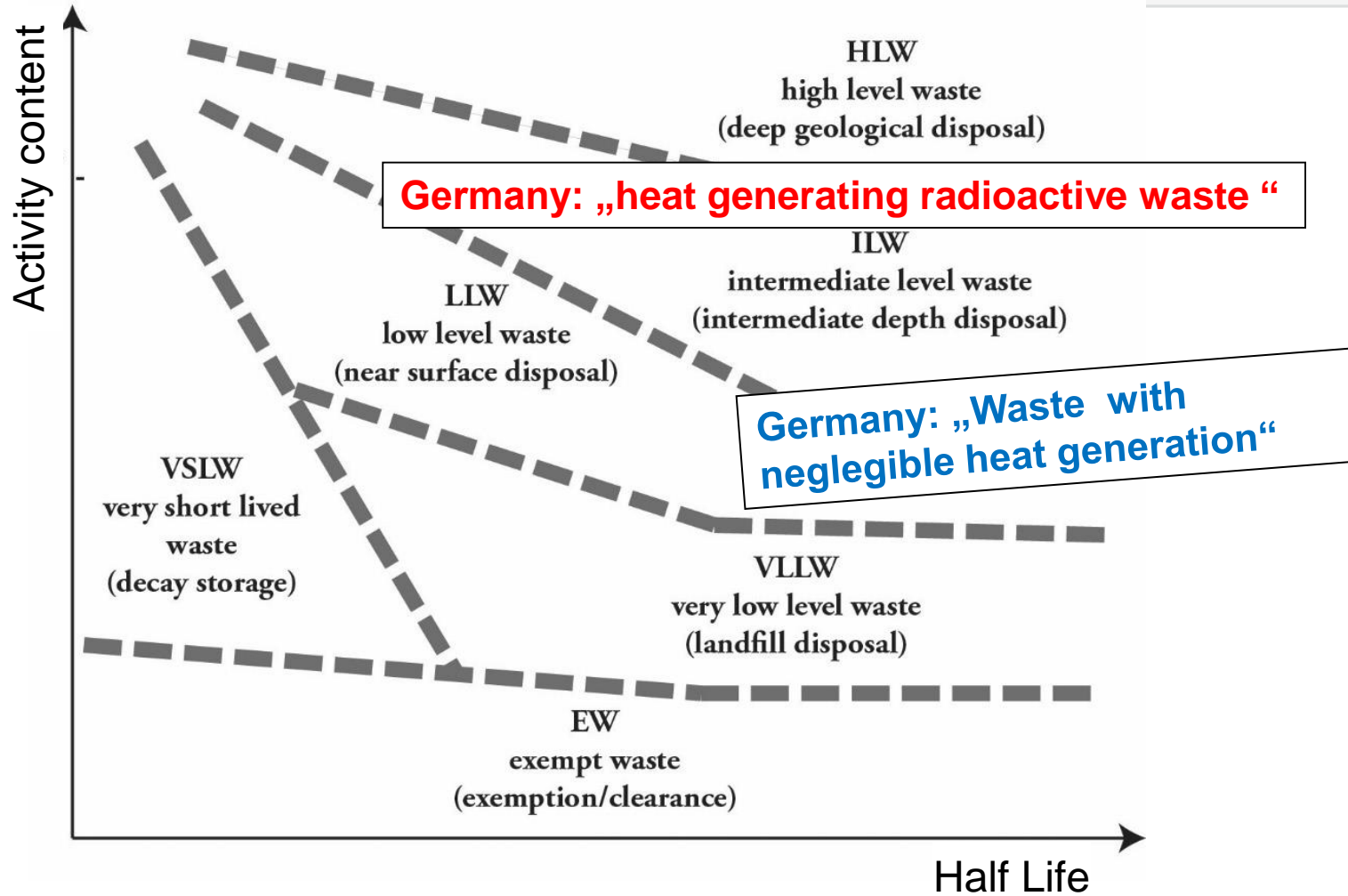


Running: 450
In Construction: 58

<http://www.kernenergie.de>

The Fuel Cycle





	Mass / Heavy Metal ton		Mass / Heavy Metal ton
1 Argentina	3 234	16 Netherlands	0.43
2 Belgium	4 300	17 Romania	762
3 Brazil	113	18 Slovakia	18 500
4 Bulgaria	943	19 Slovenia	1 263
5 Canada	33 858	20 South Africa Note	285
6 China Note	28 000	21 South Africa Note	7
7 Czech	5 000	22 Spain	3 196
8 Finland	5 000	23 Sweden	4 957
9 France	10 920	24 Switzerland	737
10 Germany	4 738	25 UK	9 585
11 Hungary	743	26 Ukraine	???
12 Italy	237	27 USA	49 352
13 Japan	13 000		
14 Rep. of Korea	7 286		
15 Lithuania	1 818	total	176 419

worldwide spent fuel generation rate about 10,500 MTHM/year.

SOURCE	LILW		SPENT FUEL		HLW		MINING & MILLING	
	Volume m ³	Activity TBq	Mass MTHM	Activity TBq	Volume m ³	Activity TBq	Volume m ³	Activity TBq
NUCLEAR FUEL CYCLE	2.2 E6	1.2 E6	1.8 E5	2.8 E10	3.4 E4	4.2 E7	1.6 E9	2.8 E4
INSTITUTIONAL ACTIVITIES	1.1 E6	7.0 E5						
DEFENCE AND WEAPON	4.0 E6	7.0 E5			8 E5	3.1 E7	2.5 E8	4.6 E3
TOTAL	7.3 E6	2.6 E6	1.8 E5	2.8 E10	8.3 E5	7.3 E7	1.8 E9	3.3 E4

[IAEA Tech Report 1591]

- Prognosis -

LILW: Waste with negligible heat generation 280.000 m³

HLW Heat generating waste total 28.000 m³

of these:

spent fuel*)	21.000 m ³
vitriified waste**)	695 m ³
Compacted waste	740 m ³
technological waste**)	3.400 m ³
SNF from research reactors.	160 m ³
SNF from HTR	1975 m ³

*) 440 t HM per year

**) from reprocessing COGEMA und BNFL

Is this a lot ?



A) Repository for chemical waste Herfa-Neurode

- Started: 1972 (BRD)

B) Repository for radioactive waste Morsleben

- Started: 1971 (DDR)





A) Repository for chemical waste Herfa-Neurode

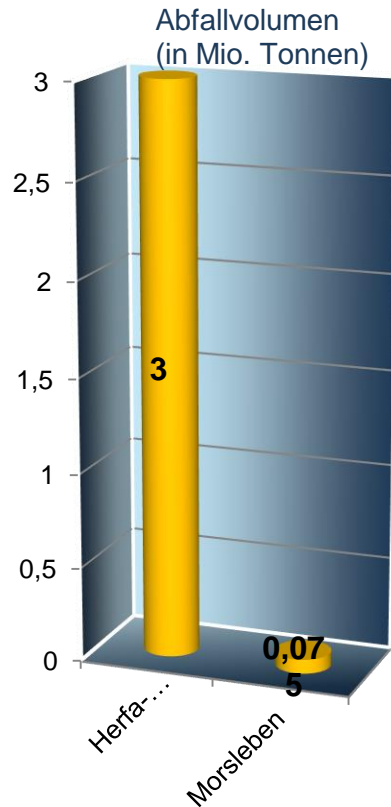
- Started: 1972 (BRD)
- Biggest repository for hazardous waste worldwide



B) Repository for radioactive waste Morsleben

- Started: 1971 (DDR)
- LLW and MLW





A) Repository for chemical waste Herfa-Neurode

- Started: 1972 (BRD)
- Biggest repository for hazardous waste
- Today 3 000 000 m³
- Operator K&S



B) Repository for radioactive waste Morsleben

- Started: 1971 (DDR)
- LLW and MLW
- Until 1998 ca. 37.000 m³ waste
- Operator: BfS

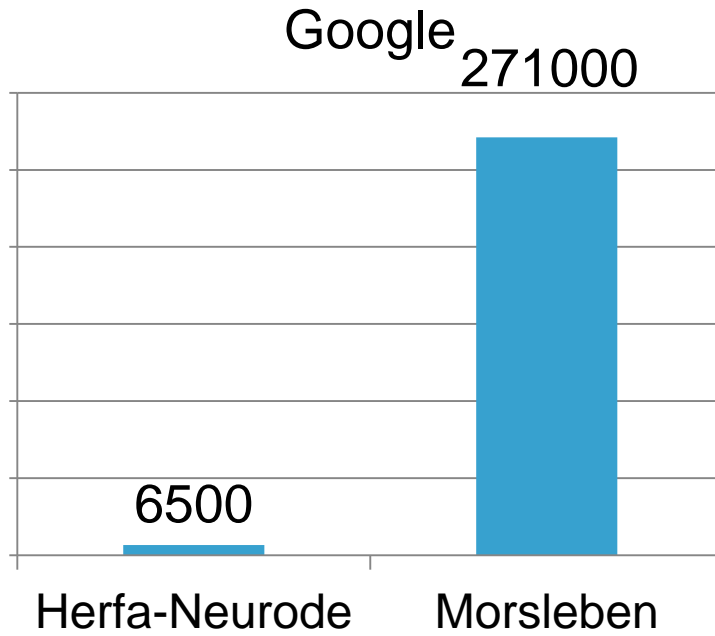


„Herfa-Neurode“

6.500 hits on www.google.de

„Morsleben“

271.000 hits on www.google.de



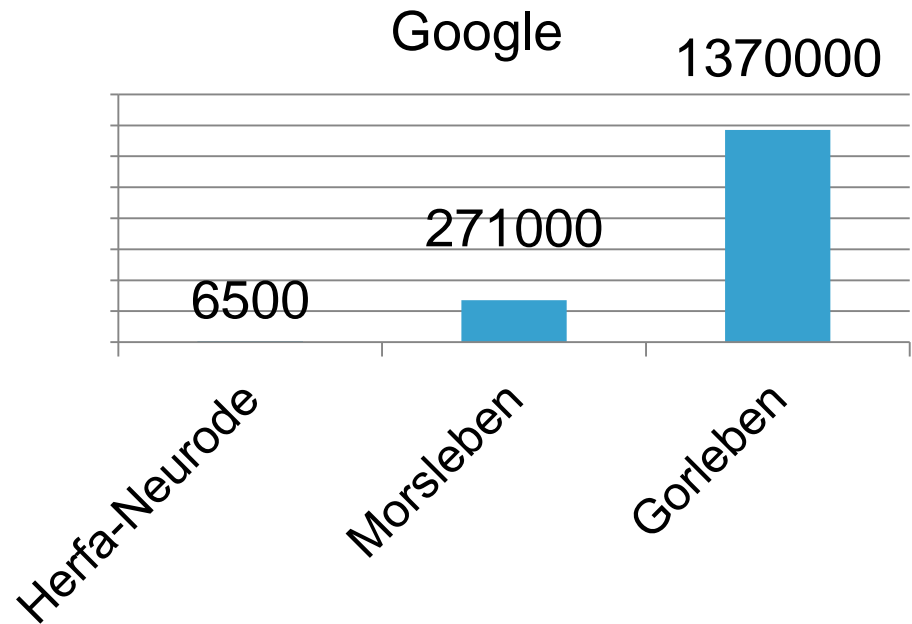
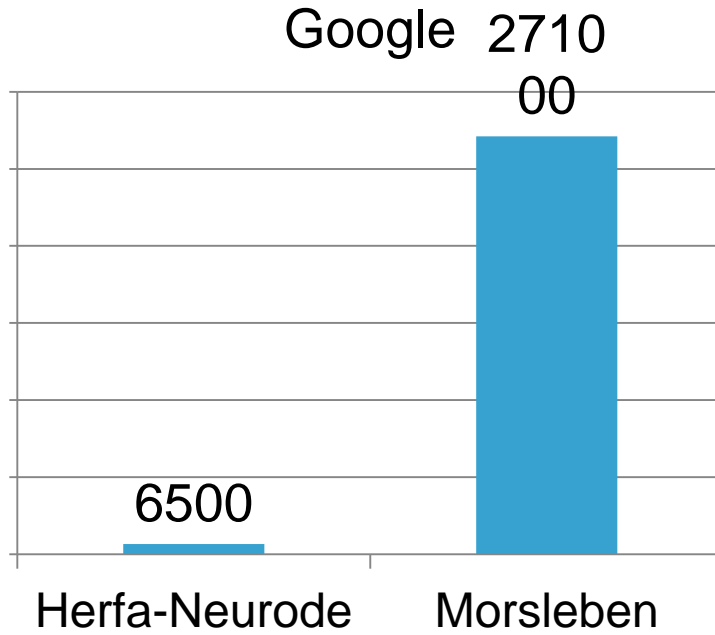
© Cord Drögemüller

„Herfa-Neurode“

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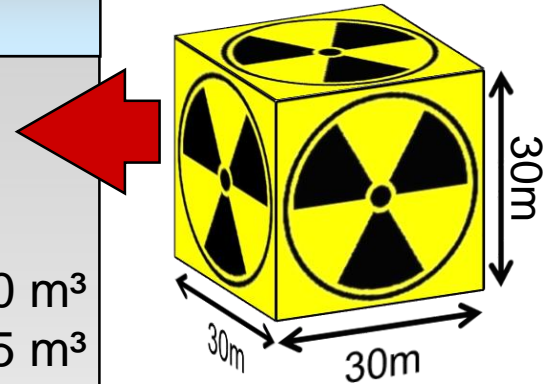
© Cord Drögemüller

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SNF from HTR	1975 m ³



Conventionel: Herfa Neurode: ~3 Mio m³

Quelle: BfS ; Basis: Ausstiegsbeschluss

A CASTOR



B POLLUX



C KBS 3V canister



D pressure cooker



E I don't have any plutonium



Hannoversche Allgemeine

Gesucht: 4000 Töpfe für Plutonium

Kann mehr, als zartes Gemüse garen: So ein einfacher Schnellkochtopf eignet sich offenbar auch, um nukleare Materialien zu lagern.

VORIGER ARTIKEL

Das Aus nach 56 Jahren



NÄCHSTER ARTIKEL

Viele Tote und Vermisste nach Fahrglück

Artikel veröffentlicht: Freitag, 16.08.2013 22:38 Uhr

Eine einfache
des Nuklearfor
irritiert die Franzo

**Wanted:
Pots for
plutonium**

HAZ 17.8.2013




**Solution:
Commercial
(SEB)pressure
cooker**


Paris. Gesucht werden 4000 Dampfdruckkochtöpfe: Aus rostfreiem Stahl und mit 17 Liter Fassungsvermögen. Das klingt zunächst nach viel Fleisch und Gemüse, nach Großküchen und Kantinen. Der weitere Text der öffentlichen Ausschreibung allerdings hat in Frankreich jetzt so manchen Leser ins Stutzen gebracht – nämlich, weil die Schnellkochtöpfe auch für den Transport „sensibler Materialien“ geeignet sein müssen, und der Hersteller ein hohes Sicherheitsniveau garantieren müsse.


Antworten auf viele offene Fragen gab jetzt das Nuklearforschungszentrum von Valduc in der Bourgogne, das per Internet-annonce einen Lieferanten für die ungewöhnliche Großbestellung gesucht hatte. Bekannt ist die Einrichtung allerdings nicht für ihre Kantine, sondern erstrangig für die Konzeption und

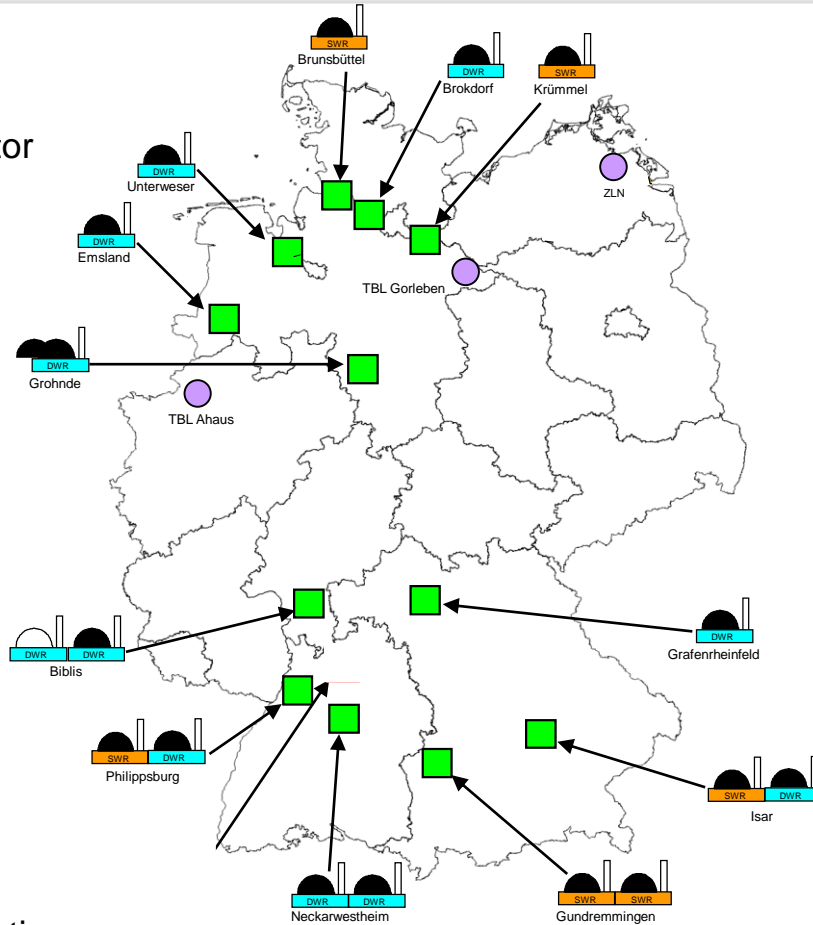
Absolut, versuchte der Direktor der Anlage von Valduc, François Bugaut, im französischen Radio zu beschwichtigen, nachdem die Anzeige für Wirbel im ansonsten hochsommerlich ruhigen Frankreich sorgte. „Wir benutzen bereits seit den sechziger Jahren Schnellkochtöpfe. Von Zeit zu Zeit muss man den Bestand erneuern. Sie dienen dazu, das Material zu verpacken und zu lagern, vor allem Plutonium.“ Die Dampfdruckkochtöpfe hätten zudem ein gutes Preis-Leistungs-Verhältnis und seien sehr robust und unzerbrechlich im Falle eines Sturzes auf den Boden. Sie könnten vor Strahlung schützen, Staubteilchen abhalten und dienten als praktische Behältnisse. „Genau, was wir brauchen“, sagt Bugaut. Lediglich das Ventil am Deckel werde vor dem ungewöhnlichen Einsatz ausgebaut.

Dass es sich bei der aufsehenerregenden Bestellung um ein profitables Geschäft für seine Branche handelt, bestätigte nun auch ein Mitarbeiter des französischen Küchenartikelherstellers SEB: Sein Arbeitgeber habe schon

-  Nuclear Power Plant
-  Pressurized Water Reactor
-  Boiling Water Reactor

-  Central Storage Facilities

-  Storage Facility in operation



- Intermediate Storage
- Dry Storage
→ Air cooling–
convection



BLG Gorleben (© GNS)

Wet storage: active cooling



ATOMMÜLL

Weg! Weg!! Weg!!!

Bloß weg mit dem Atommüll. Doch wohin? Eine kleine Geschichte der Entsorgungspolitik – ihrer Illusionen, Fantasien und Lügen

VON Manfred Kriener | 13. September 2012 - 08:00 Uhr

© Nigel Treblin/Reuters

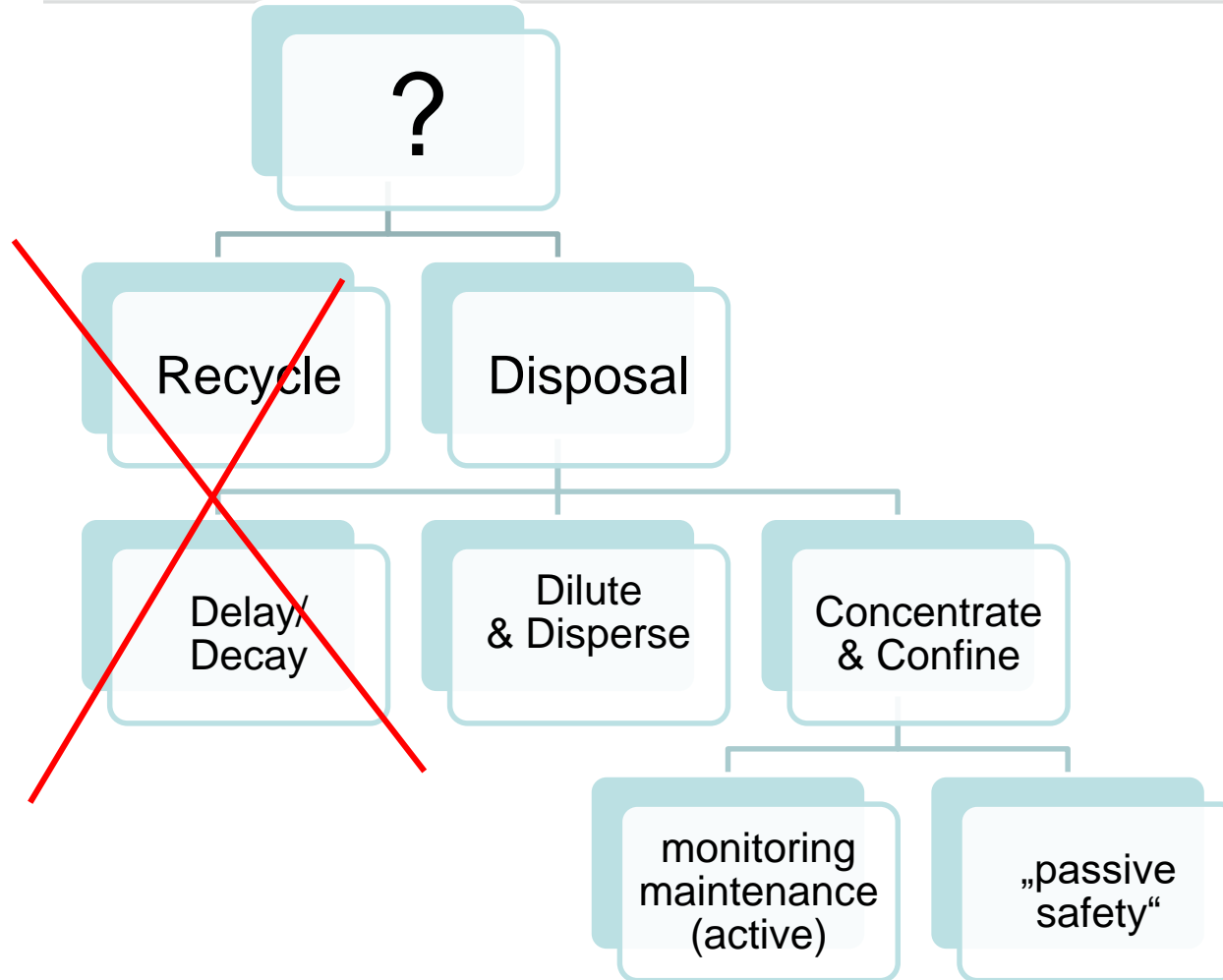


- **Radiation** (γ !) -> **shielding**
- **Volatile** radionuclides -> **tightness** of containers for transport, storage, disposal.
- **Long-lived** radionuclides -> **timeframes** of isolation and/or monitoring.
- **Heat** production -> **cooling**, layout of transport means, storage disposal facilities
- **Chemical composition and physical condition**
-> **reconditioning** for packaging, transport, storage, and disposal.
- Potential **radiological impact** caused by different radionuclides determines the radiological hazard of the waste -> **management**.
- The same applies of course to the **chemotoxic** potential.
- Concentration of fissile nuclides, geometric configuration -> potential for **criticality**.
Avoid these **configurations**

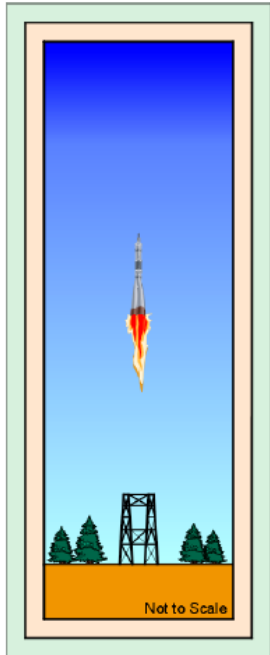
© Klaus-J. Röhlig (Thanks)

Radioactive Waste: Strategies

- **Until 1994:**
 - SNF reprocessing as **only** option (with plans for reprocessing in Germany)
 - Central SNF interim storage in Gorleben, Ahaus and Lubmin
- **From 1994 on:**
 - Direct SNF disposal as **additional** SNF management option, reprocessing in La Hague and Sellafield
 - Vitrified high-level waste from reprocessing: central interim storage in Gorleben
- **2000:** agreement between Federal Government and utility companies:
 - spent fuel management **limited to direct disposal**, transports to reprocessing plants abroad no longer permitted
 - interim storage facilities to be built at reactor sites in order to avoid transports



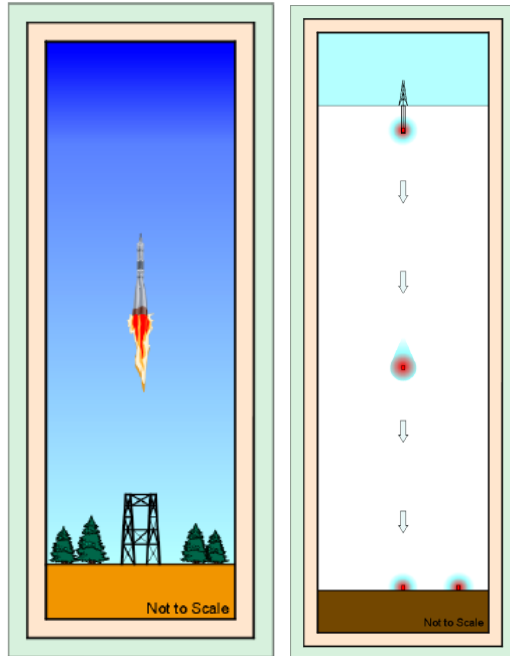
Space



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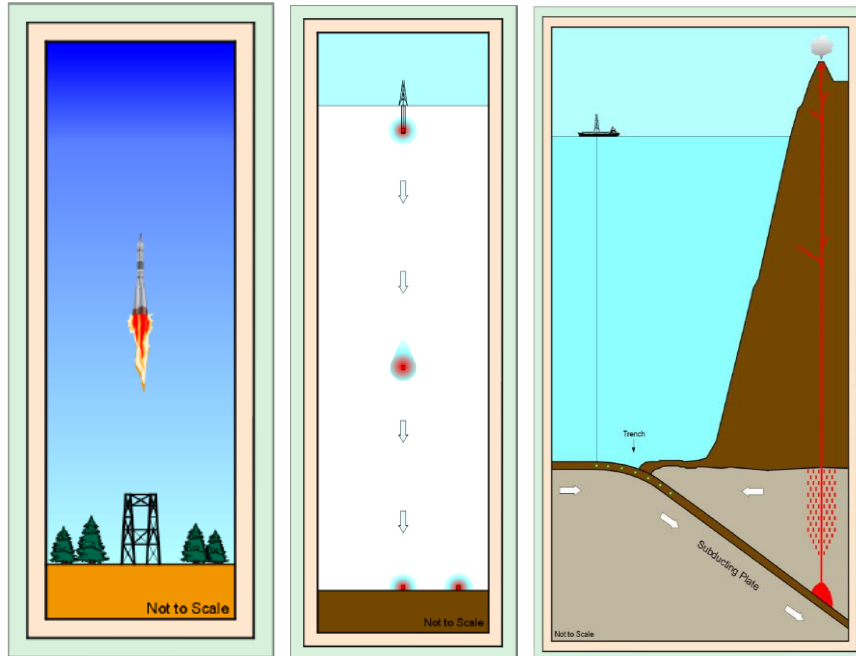
Space

„eternal“ ice



© UK NIREX / NDA

Space „eternal“ ice subduction zone



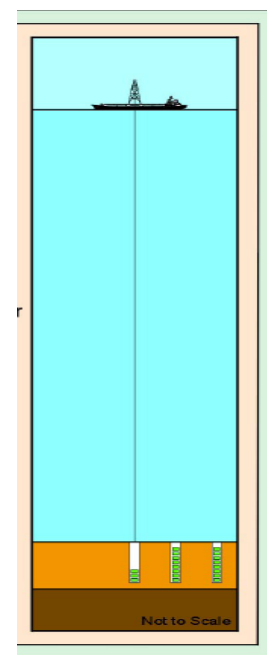
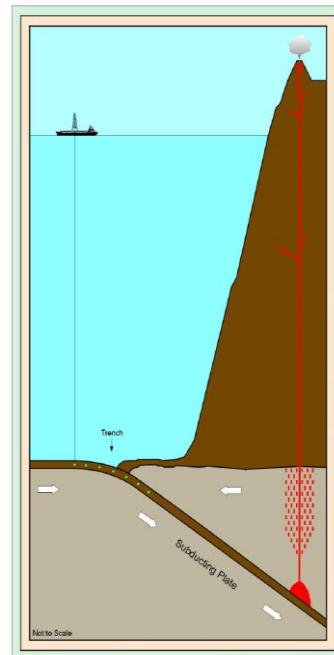
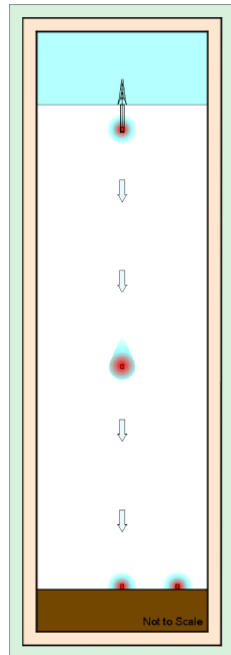
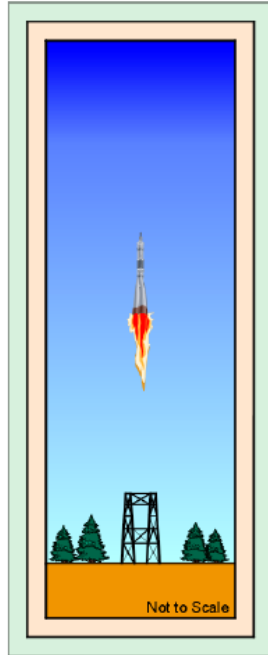
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Space

„eternal“ ice

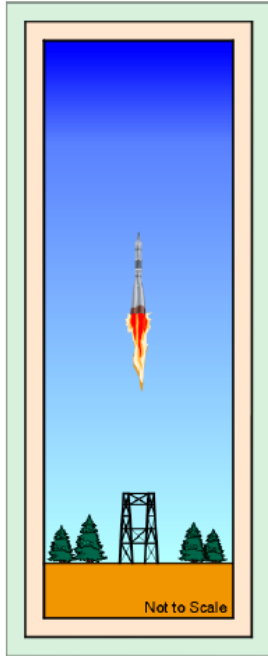
subduction zone

seabed

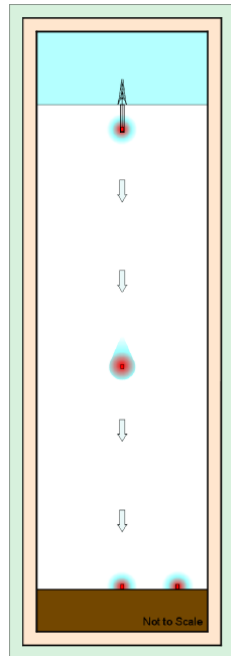


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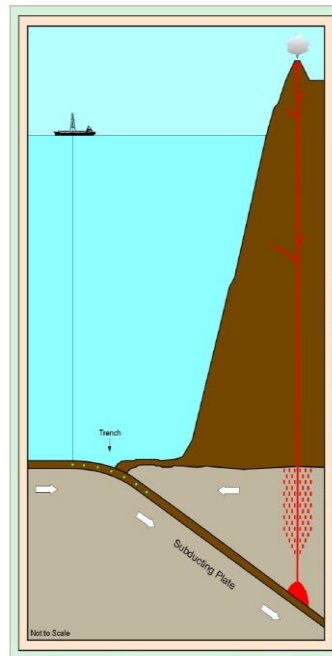
Space



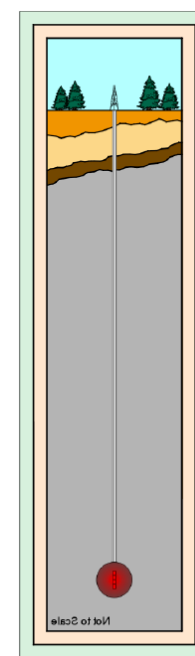
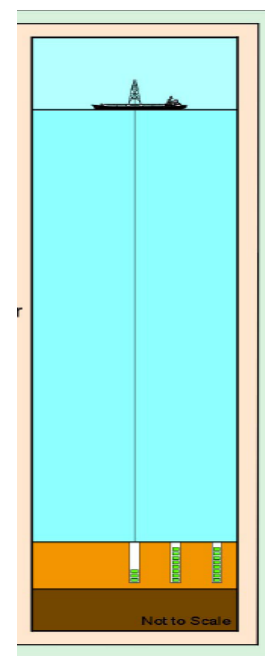
„eternal“ ice subduction zone



seabed

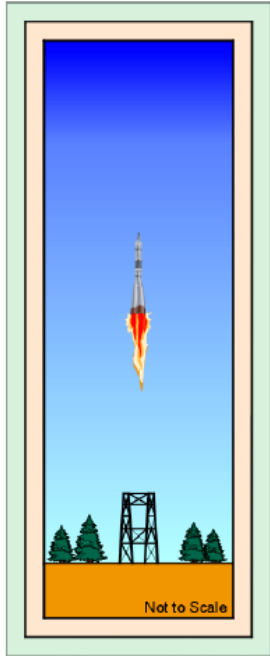


rock melting

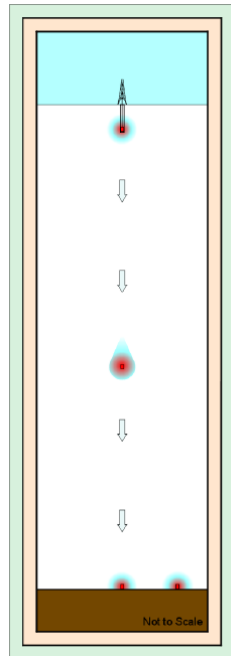


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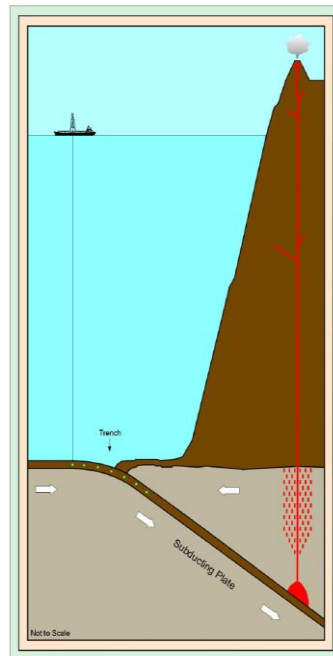
Space



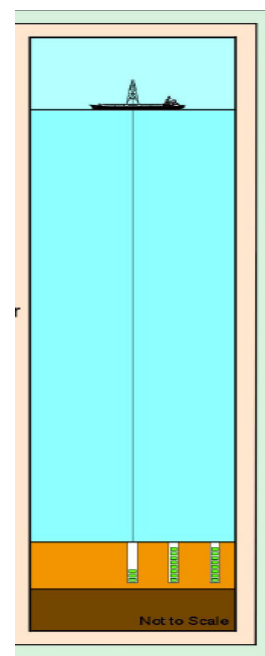
„eternal“ ice



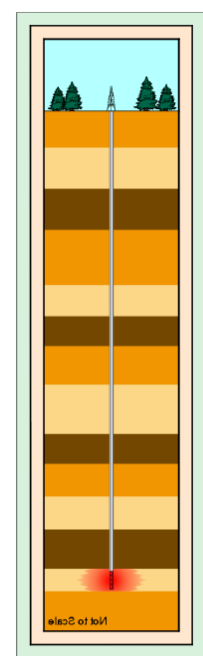
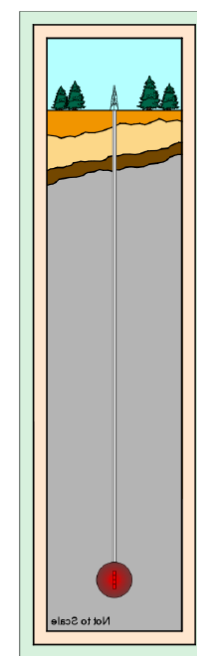
subduction zone



seabed



rock melting injection



© UK NIREX / NDA

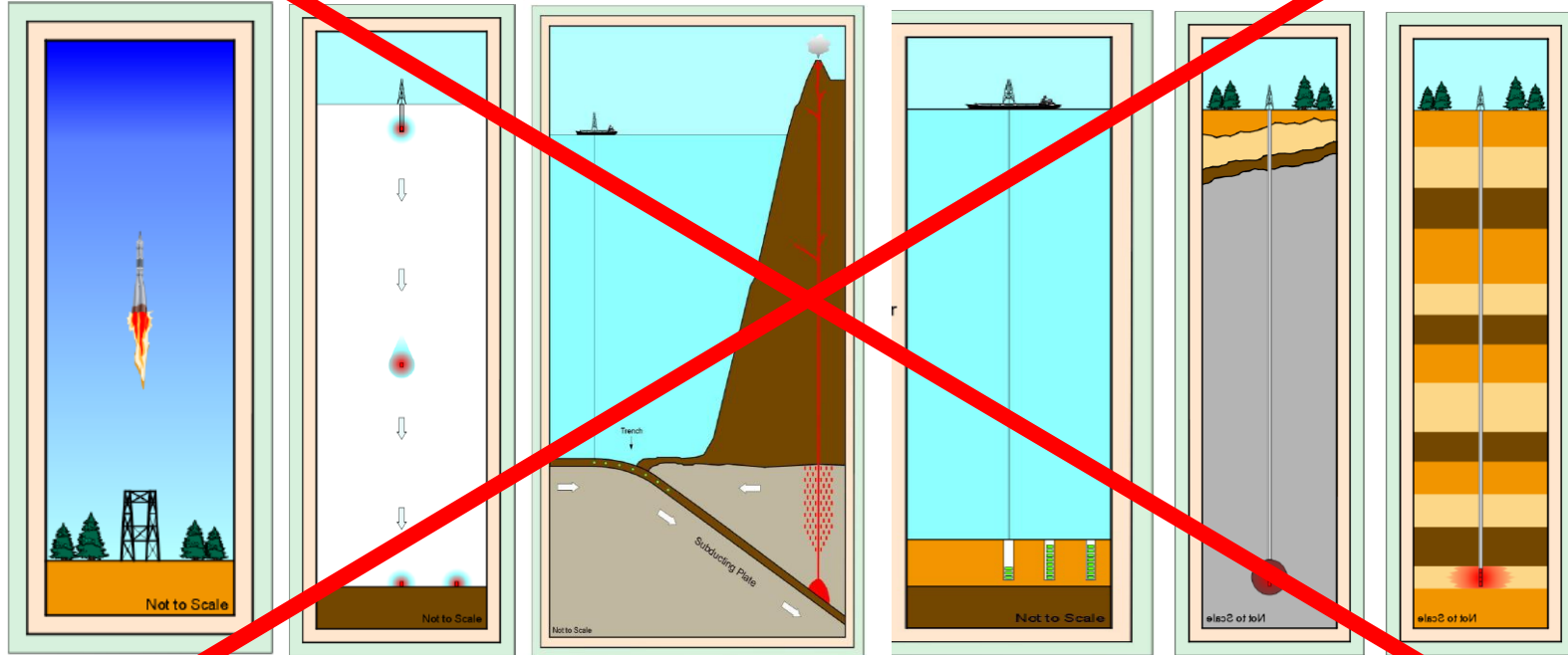
Space

„eternal“ ice

subduction zone

seabed

rock melting injection



© UK NIREX / NDA

Longterm Controlled (surveyed) Storage

- Technically feasible, in operation
- Central safety element: **active action by operators**
- Retrieval anytime, simple
- Particularly advisable for resources (**not vitrified waste!**)

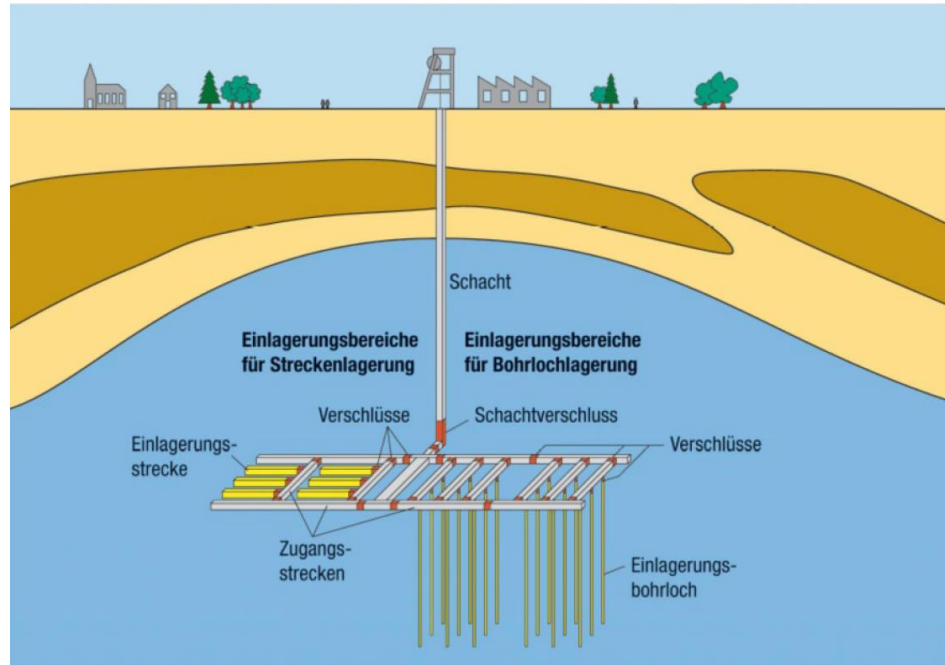
Longterm Controlled (surveyed) Storage

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Ultimate Disposal in Deep Geological Formations

- Technically feasible
- passive safety (**no need for maintenance**)
- No measures for retrievability, recovery difficult
- For waste not for resources



Ultimate Disposal in Deep Geological Formations

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- passive safety (no need for maintenance)
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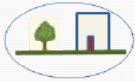
”Retrievable ” Disposal as a Compromise?

- Retrieval/ recovery?
- Time spans (500 years?)
- Surveillance? Information? **active action by mankind?**
- Safety concerns when not retrieved in time

Ultimate Disposal in Deep Geological Formations

- Technically feasible
- passive safety (**no need for maintenance**)
- No measures for retrievability recovery difficult
- For waste not for resources

1 Packaged
Waste in
Storage



Before disposal

RETRIEVABILITY



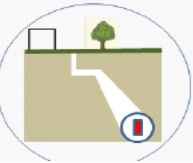
ease of retrieval

SAFETY ASSURANCE



active controls

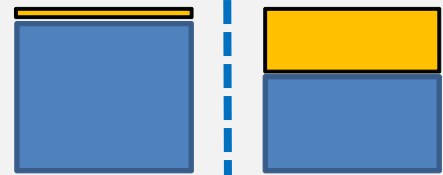
Waste package emplacement



Before disposal

Waste in deep geological disposal cell

RETRIEVABILITY

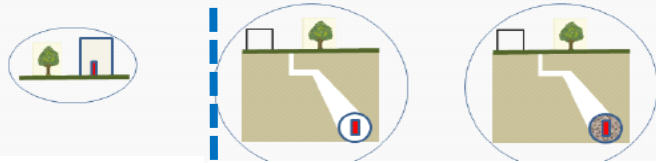
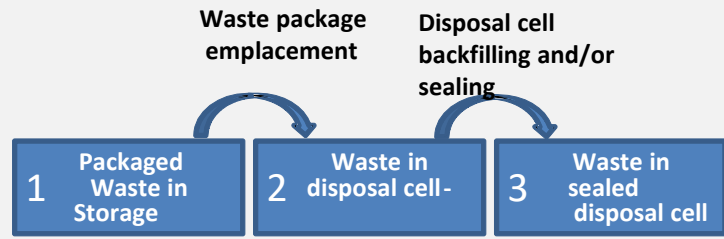


ease of retrieval

SAFETY ASSURANCE



active controls



Before disposal

Waste in deep geological disposal cell

RETRIEVABILITY

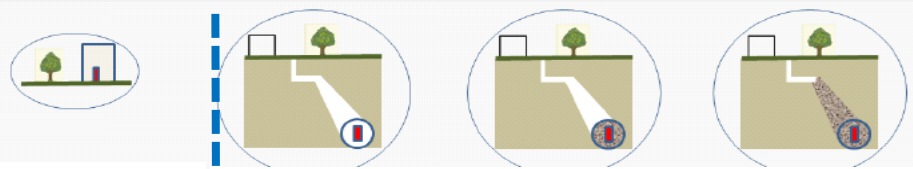
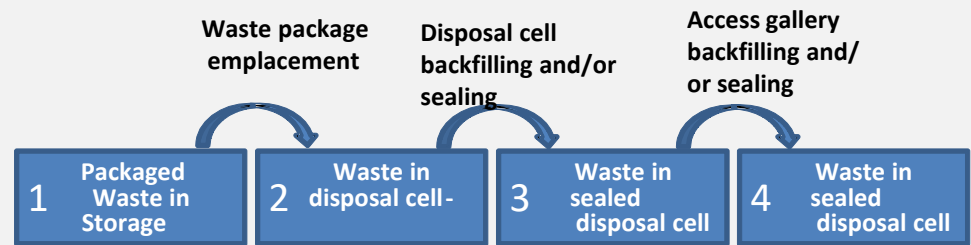


ease of retrieval

SAFETY ASSURANCE

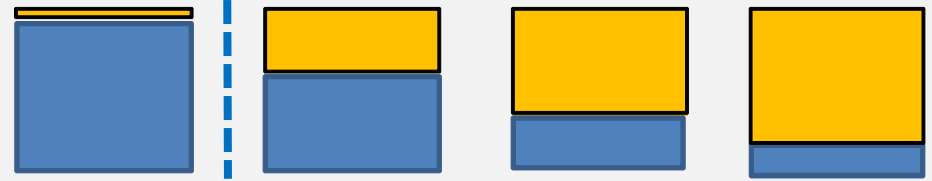


active controls



Before disposal | Waste in deep geological disposal cell

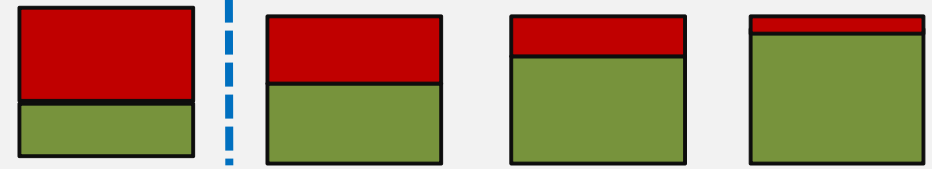
RETRIEVABILITY



ease of retrieval

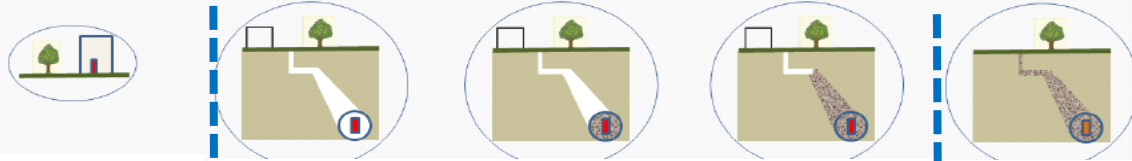
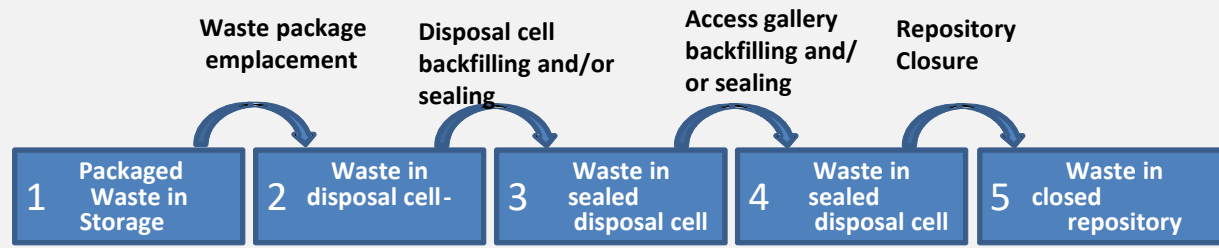
cost of retrieval

SAFETY ASSURANCE



active controls

passive safety



Before disposal

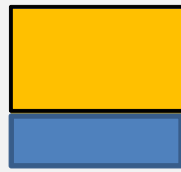
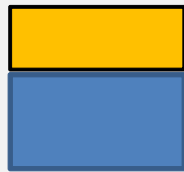
Waste in deep geological disposal cell

disposal cell sealed

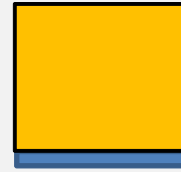
RETRIEVABILITY



ease of retrieval



cost of retrieval



SAFETY ASSURANCE

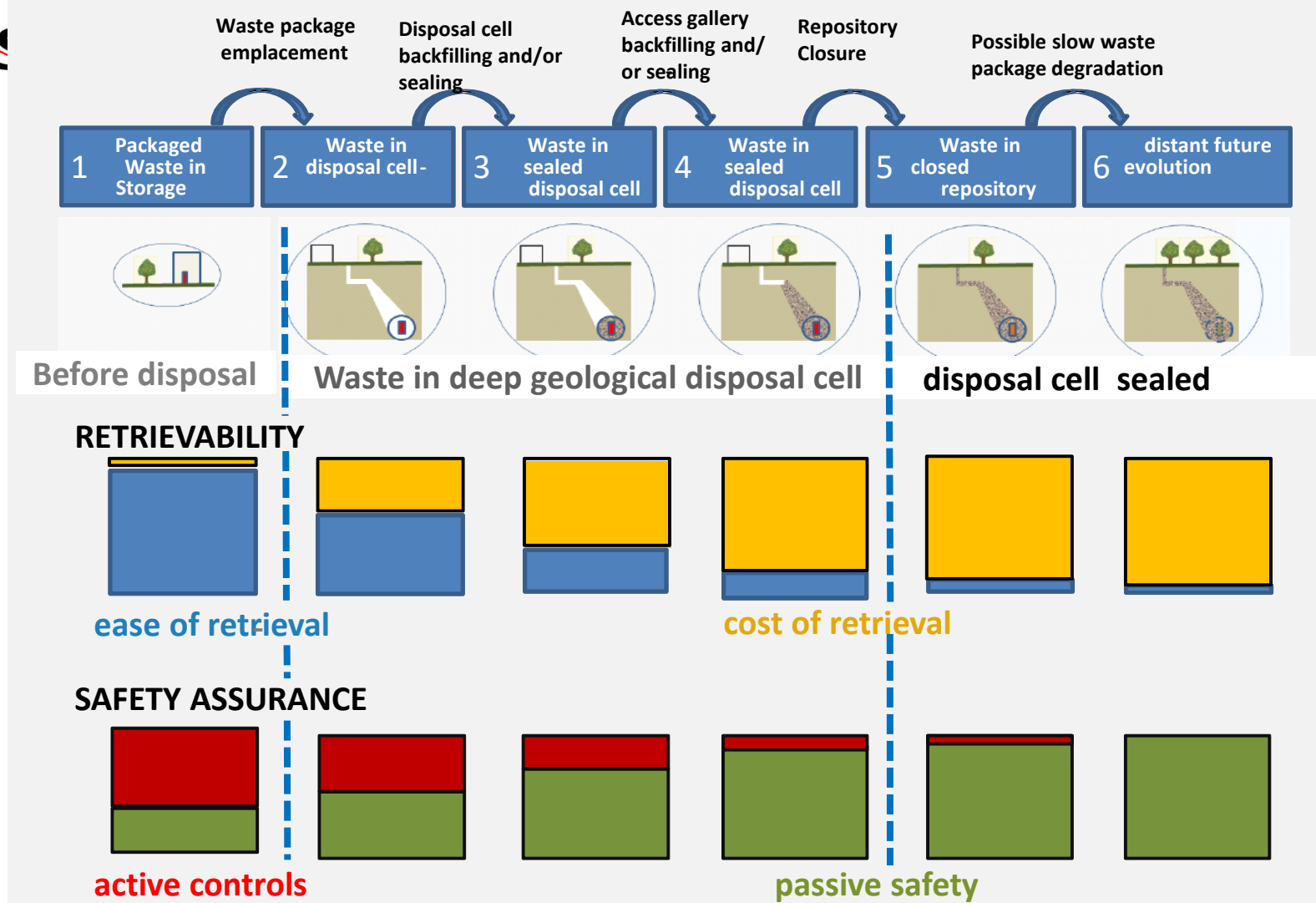


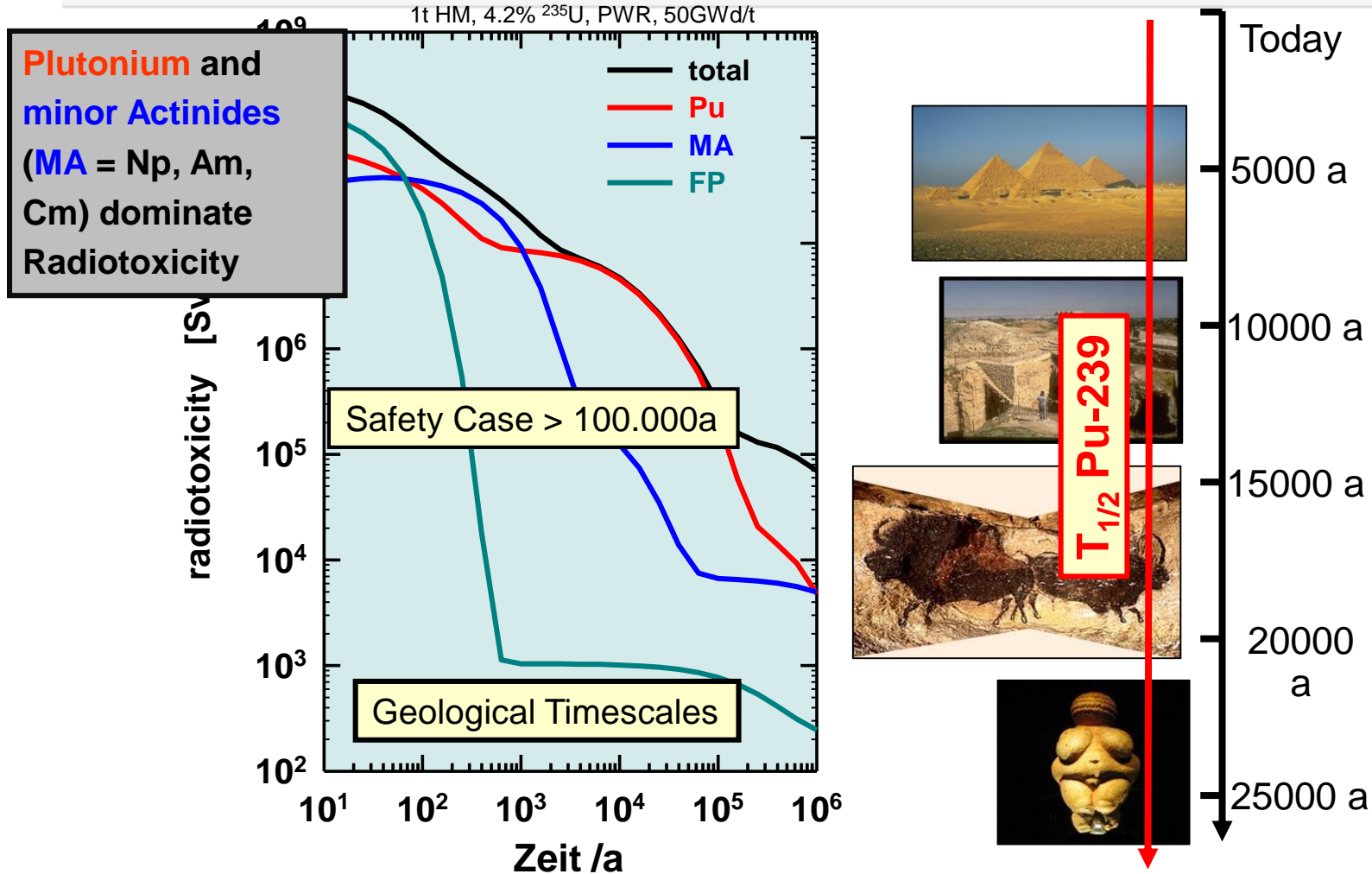
active controls

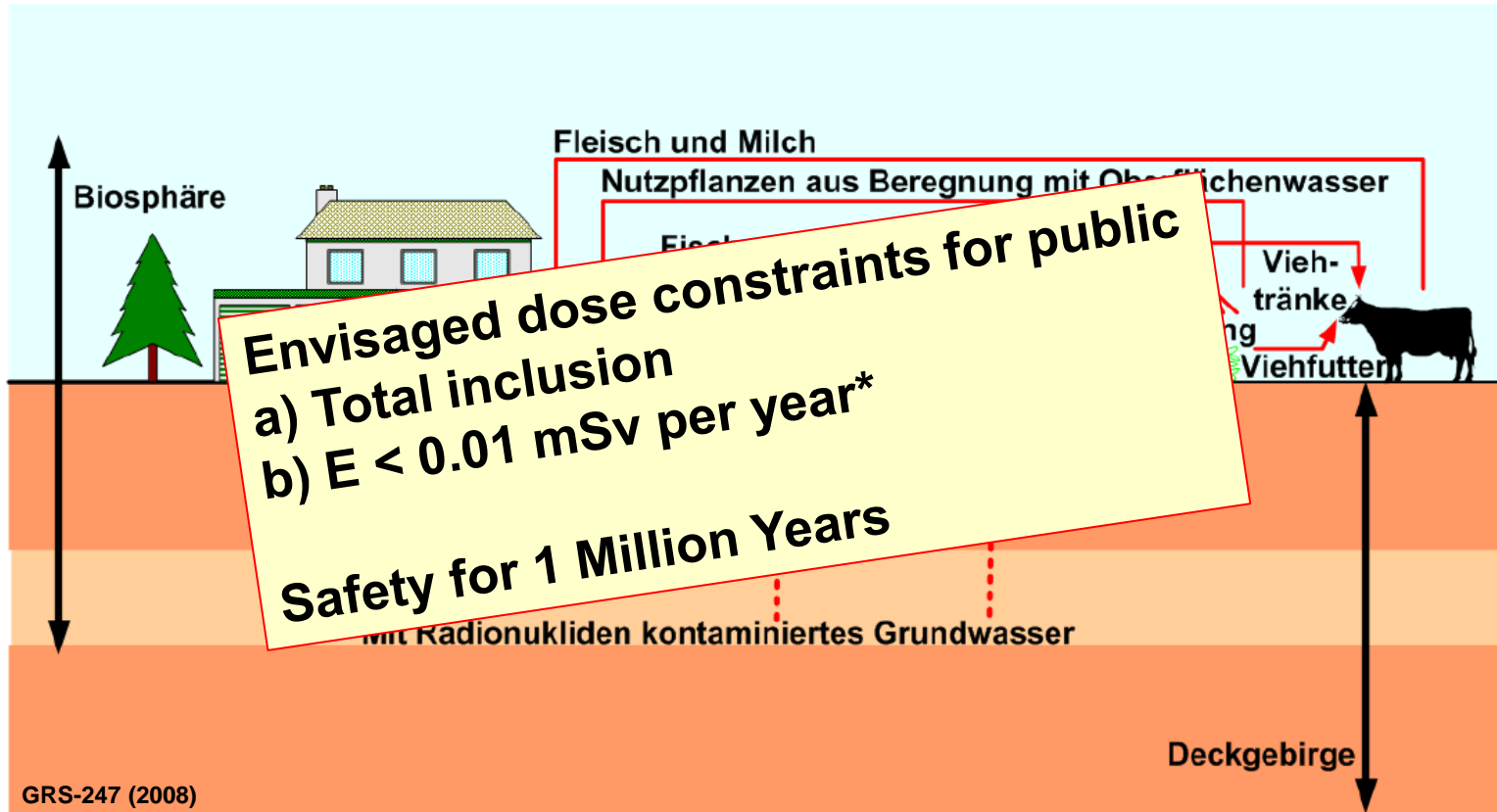


passive safety

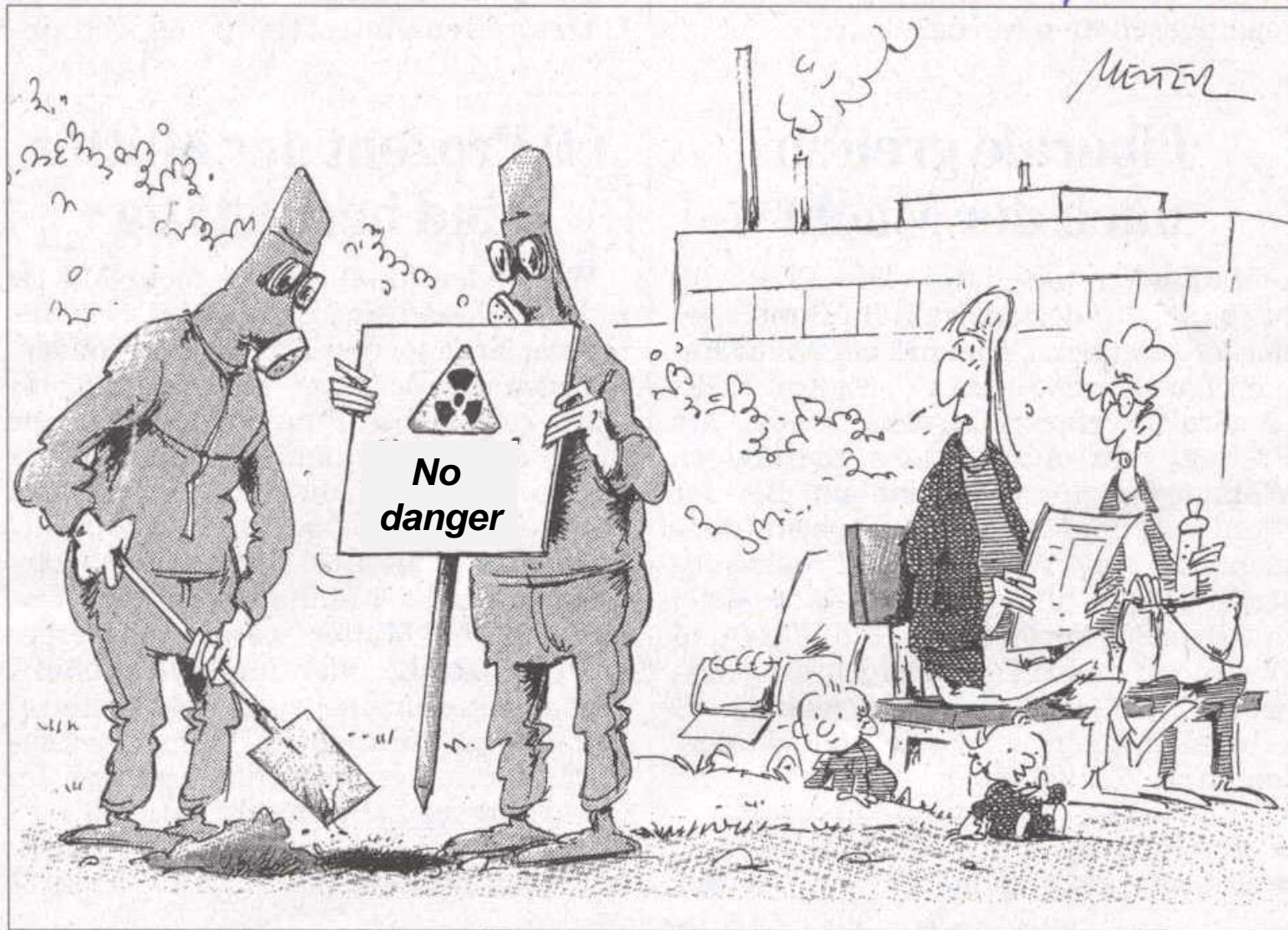




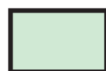




* Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety
Safety requirements for the disposal of heat generating radioactive waste (2010)



Property	Rock salt	Claystone	Crystalline e.g., granite
Heat conductivity	high	low	medium
Hydraulic conductivity	practically impermeable	very low to low	very low to conductive
Mechanical strength	medium	low to medium	high
Deformation Behaviour	viscous (creep)	pto brittle	brittle
Vault Stability	inherent stability	low	high to low



Favourable feature



unfavourable feature

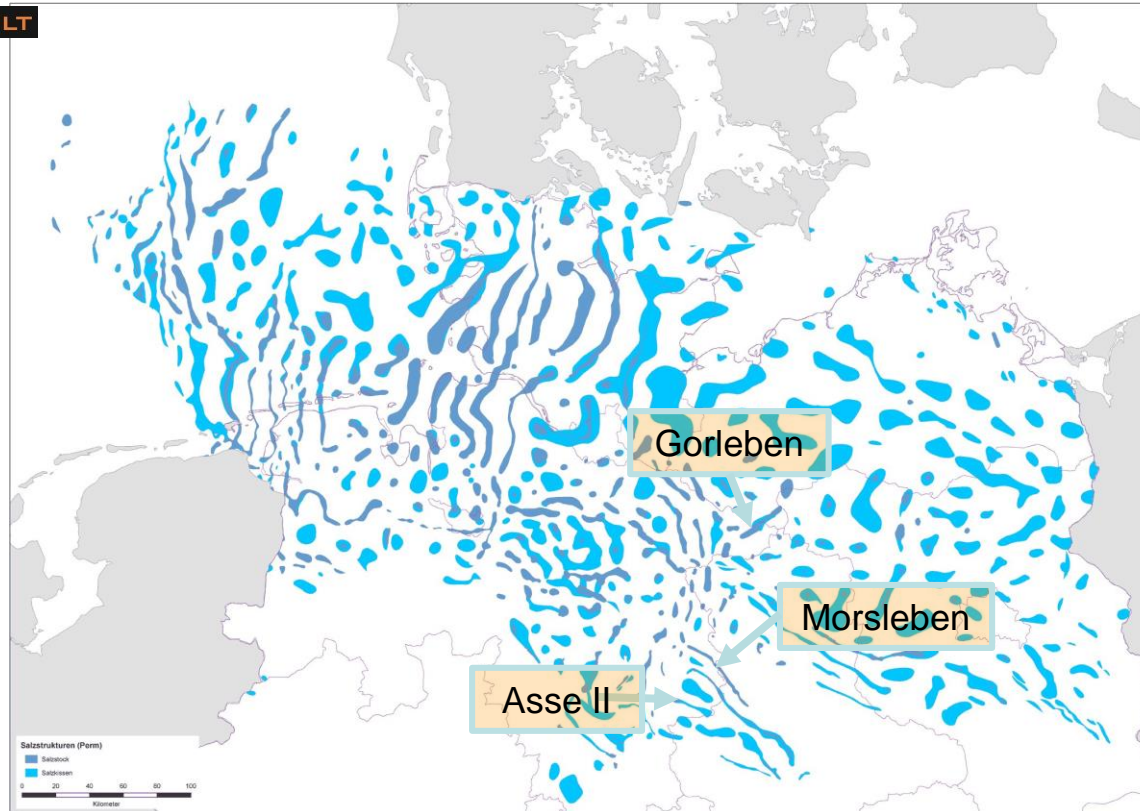


medium

Property	Rock salt	Claystone	Crystalline e.g., granite
In-situ stress	litostatically isotropic	anisotropic	anisotropic
Solubility	high	very low	very low
Sorption behavior	very low	very high	medium to high
Heat resistance	high	low	high

Favourable feature :
 unfavourable feature
 medium

R·P·CONSULT

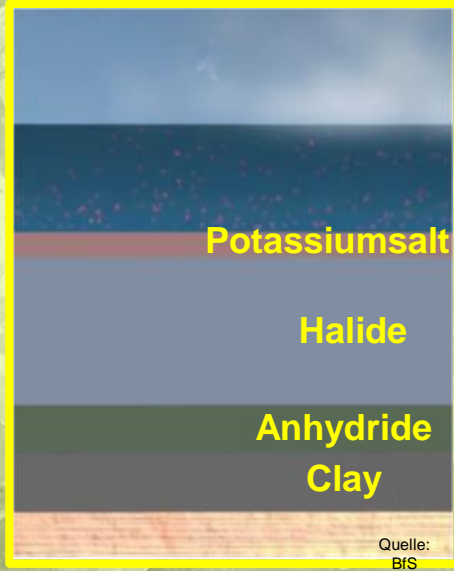


R·P·CONSULT

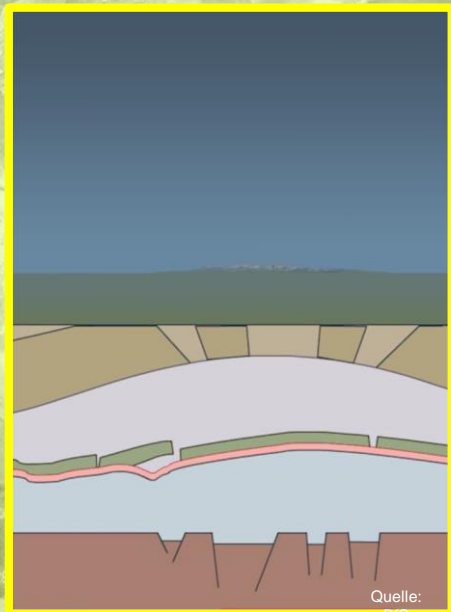
00:00

260 mio years ago the „Zechsteinmeer“ started to dry out. Several sedimentary layers formed.

As an example the evolution of the salt dome Morsleben – projected to 24h



R·P·CONSULT



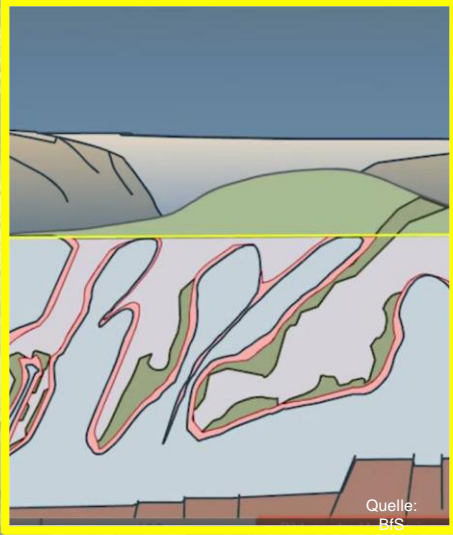
Quelle:
BfS



03:00 :

230 mio years ago fractures formed. Due to their low density, sedimentary layers move upward

R·P·CONSULT



16:00 :
90 mio years ago
the former
horizontal layers
fold up due to
lateral pressure.
The Caprock and
the salt mirror
„Salzspiegel“
form.

R·P·CONSULT



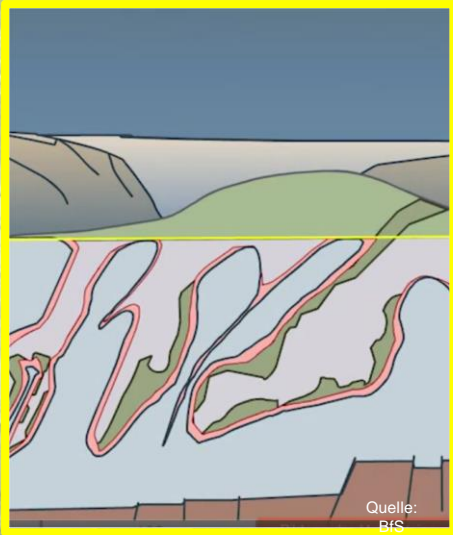
18:00 :
65 mio years
ago, the
dinosaures
became extinct.

R·P·CONSULT

18:00 :
65 mio years
ago, the
dinosaures
became extinct.



R·P·CONSULT

**21:00 :**

**Requirement of
the German
commission for
Radioactive
Waste Disposal:
Until 34 mio
years ago
(Oligozen) no
fault
(Verwerfung).**

R.P. CONSULT



Quelle:
BfS



24:00 :

**Buit,
commissioning
and operation of
repository mine
are finished.
The post closure
phase starts**

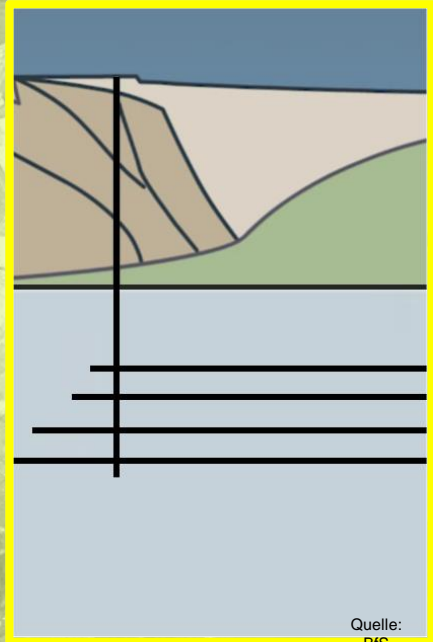
R·P·CONSULT



**24:00
+ 3 seconds**

**The long term
safety phase for
LAW/MAW of
10.000 years is
finished.**

R·P·CONSULT



Quelle:
BIS



**24:00
+ 3 minutes**

**The long term
safety phase for
HAW of 1 mio
years is finished.**

- **Repository Site selection act**
 - Effective August 2017
 - Search for site until 2031
 - „Learning Law“

- **Decommissioning/Disposal Fund Act**

- **Radioactive waste management transition act**

- **Follow-Up Liability Act**



Bei uns? Geht gar nicht!

»G...en ist überall«, rufen die Atomkraftgegner. Sie ahnen nicht, wie recht sie haben. Eine Reise zu den möglichen Standorten für ein Atommüll-Endlager **VON FRANK CRIESCHNER**

Not in my backyard

Wo kann der Atommüll bleiben?

Bodenformationen, die für ein unterirdisches Endlager infrage kommen

- Salzstock
- Tonsschicht
- Fels
- Salzstock mit günstigen Eigenschaften
- Salzstock Gorleben

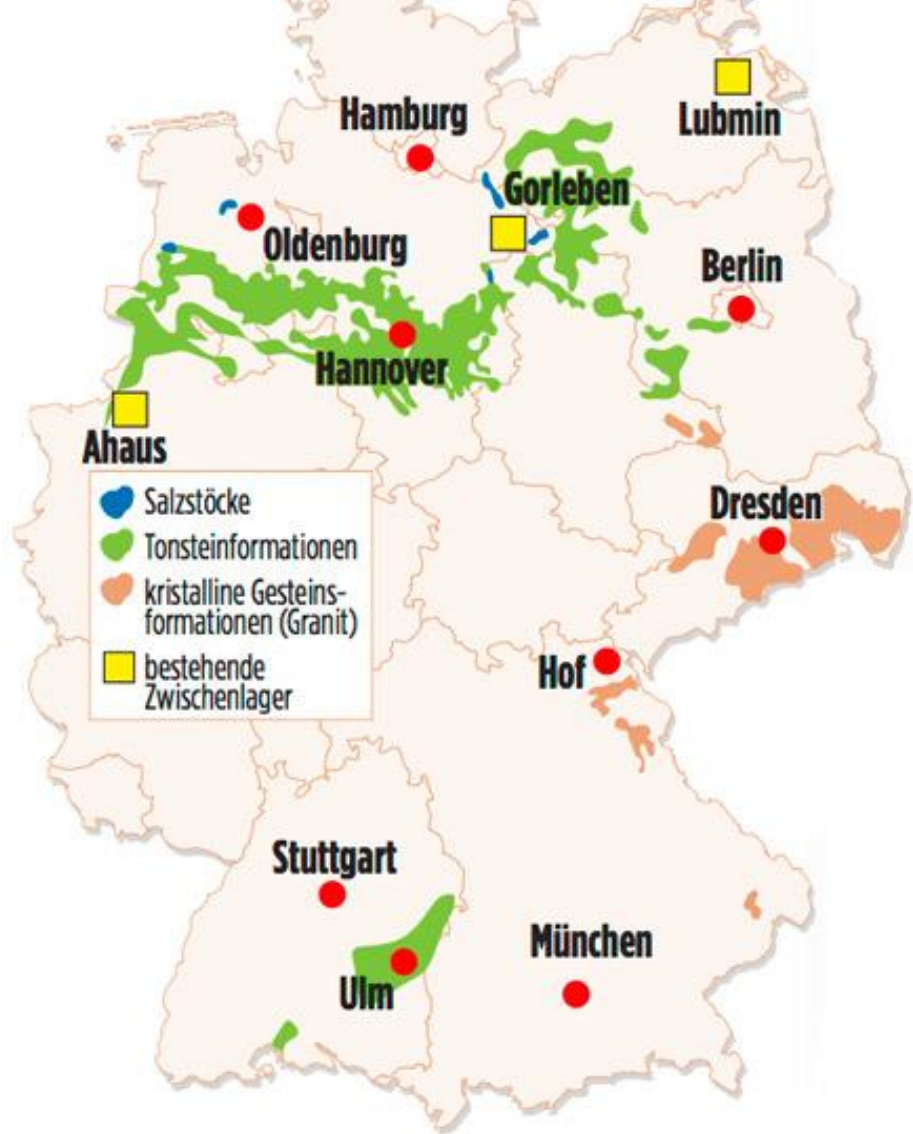


Wo ist der radioaktive Abfall jetzt?

Hochradioaktiver Müll wird provisorisch gelagert, Endlager gibt es nur für schwach- und mittelaktiven Abfall

- Kernkraftwerk
- stillgelegtes Kernkraftwerk
- Endlager
- zentrales Zwischenlager
- Zwischenlager





-  Salzstöcke
-  Tonsteinformationen
-  kristalline Gesteinsformationen (Granit)
-  bestehende Zwischenlager

-  **Rock salt**
-  **Clay stone**
-  **Crystalline (Granite)***
-  **Interim storage**

* No save enclosure, strongly fractured

Federal Ministry for the Environment, Nature
Conservation, Building and Nuclear Safety
(BMUB)

Political Responsibility

Political Responsibility

Regulating Responsibility

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

Federal Office for the Safety of Nuclear Waste Management (BfE)

reports

controls

- Supervisory body for Asse, Morsleben and Schacht Konrad
- Regulator role in the nationwide search for a site for HAW
- Responsible for interaction with the public

Political Responsibility

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB)

reports

controls

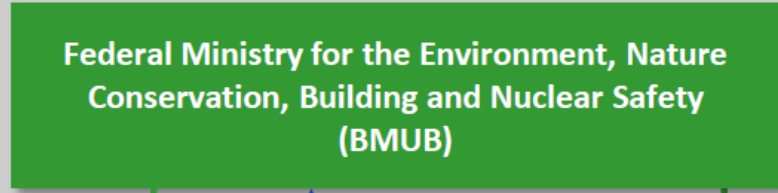
Federal Office for the Safety of Nuclear Waste Management

Regulating Responsibility

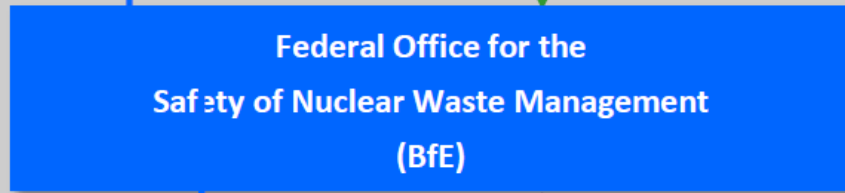
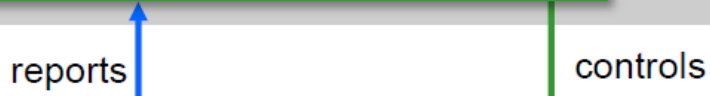
- Operates Asse and Morsleben (and Gorleben mine)
- Constructs and operates Schacht Konrad
- Implementer role in the nationwide search for a site for HAW. Search formally started on 5th September 2017

Federal Company for Radioactive Waste Disposal (BGE)
(federally owned company under private law)

Planning, Construction, Operation and Decommissioning Responsibilities



Political Responsibility



Regulating Responsibility



- 9 (later 18) independent and pluralistic members
- 6 (later 12) appointed by Federal parliament
- 3 (later 6) nominated by a participation procedure
- Has to guaranty the openness of the selection process
- Has the right to report, but no right to intervene directly



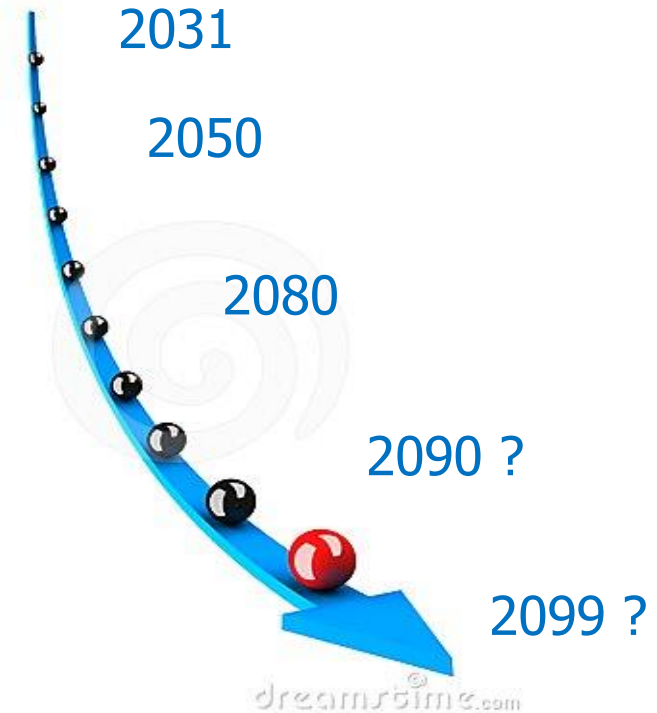
Planning, Construction, Operation and Decommissioning Responsibilities

**“Nationales Begleitgremium”
(National Monitoring Panel)**

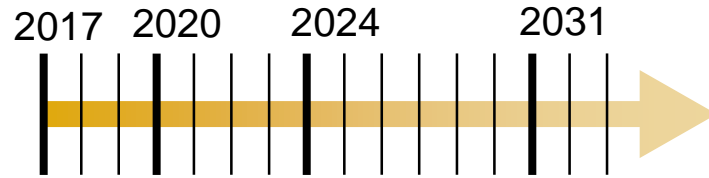
- New national fund organized as public trust
- NPP operators have transferred 23 556 Mio € to the fund no further liability of the operators for interim storage and final disposal
- The fund has to finance all costs related to interim storage and final disposal



- Stage 1. Site selection
- Stage 2. Subsurface construction and commissioning of repository
- Stage 3. Waste emplacement into the repository
- Stage 4. Monitoring phase
- Stage 5. Closure / post operation phase



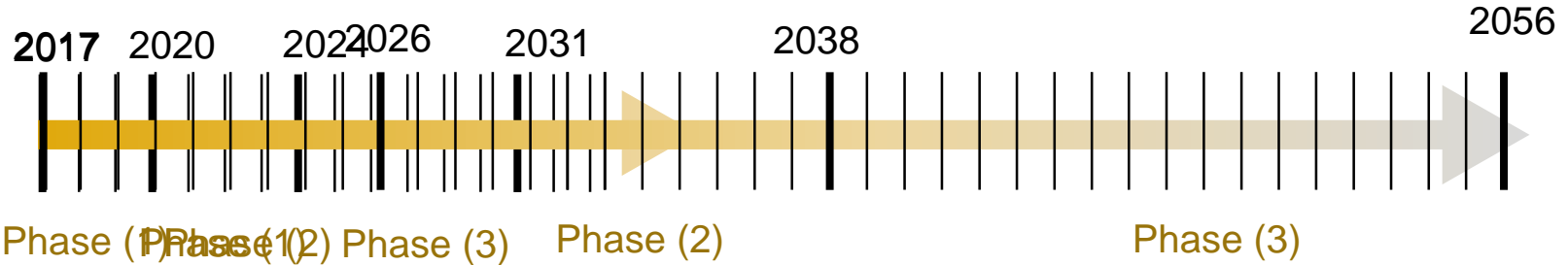
Stage 1. Site selection procedure



Phase (1) Phase (2) Phase (3)

<p>Determination of surface exploration regions for exploratory (§ 14 StandAG)</p>	<p>Decision on subsurface exploration and exploratory programmes (§ 17 StandAG),</p>	<p>Subsurface exploration (§ 18 StandAG), final comparison of sites</p>
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Stage 1. Site selection procedure



Determination of regions for surface exploration (§ 14 StandAG)
 Decision on subsurface exploration (§ 17 StandAG),
 Subsurface exploration (§ 18 StandAG) final comparison of sites
 Decision on subsurface exploration and exploratory programmes (§ 17 StandAG),
 Subsurface exploration (§ 18 StandAG), final comparison of sites

Subsurface exploration (§ 18 StandAG), final comparison of sites

Commission:

- The **first** stage may take **35 to 61 years**
- Waste emplacement not before 2100
- Closure well into 22nd century

- maximum safety during the entire process and for the sealed repository
- the widest possible participation of the public and the design of the entire process as a self-questioning system
- the shortest possible duration of the procedure



.... Cannot be achieved simultaneously

6. ENERGIEFORSCHUNGSPROGRAMM (FF BMWi)

 Federal Ministry
of Education
and Research

HGF

Programm-
orientierte
Förderung (POF)

Nachwuchsförderung
in anwendungs-
bezogener standort-
unabhängiger
Grundlagenforschung

Projektförderung
Projektträger:
PTKA

 Federal Ministry
of Economics
and Technology

BAM

BGR

Ressort-
forschung

Förderkonzept
„Forschung zur
Entsorgung
radioaktiver Abfälle“

Anwendungs-
bezogene standort-
unabhängige
Grundlagenforschung
(inkl. Nachwuchs)

Projektförderung
Projektträger:
PTKA / PT-GRS

 Federal Ministry for the
Environment, Nature Conservation
Building and Nuclear Safety

BfE

BfS

Ressortforschungsplan

Standort
auswahl

Konrad

Ressortforschung u.a.
zur Standortauswahl,
Einrichtung von End-
lagern sowie
Sicherheitsfragen der
Entsorgung

ASSE

ERAM

Auftragsvergabe
BMUB / BfS / BfE

Nukleare Sicherheitsforschung.....

4.5.1 Reaktorsicherheitsforschung.....

4.5.2 Entsorgungs- und Endlagerforschung.....

4.5.3 Strahlenforschung.....

Research for nuclear safety

- Reactor safety research
- Disposal and repository research
- Radiation research



FORKA - Forschung für den Rückbau kerntechnischer Anlagen“ durch das Bundesministerium für Bildung und Forschung (BMBF)

Aktuelle Änderung
<https://www.bmwi.de/Presse/Pressemitteilungen/Pressemitteilungensuche?ID=1872>

Decommissioning

ig-




FORKA – Forschung für den Rückbau kerntechnischer Anlagen

Förderkonzept: Rückbau und Entsorgung

IV. In Nummer 1 werden die Absätze 6 bis 16 gestrichen und folgende Sätze angefügt:

Für die projektgeförderte Forschung und Entwicklung zu Stilllegung und Rückbau kerntechnischer Anlagen stehen rund 6 bis 8 Millionen Euro Projektfördermittel pro Jahr zur Verfügung.



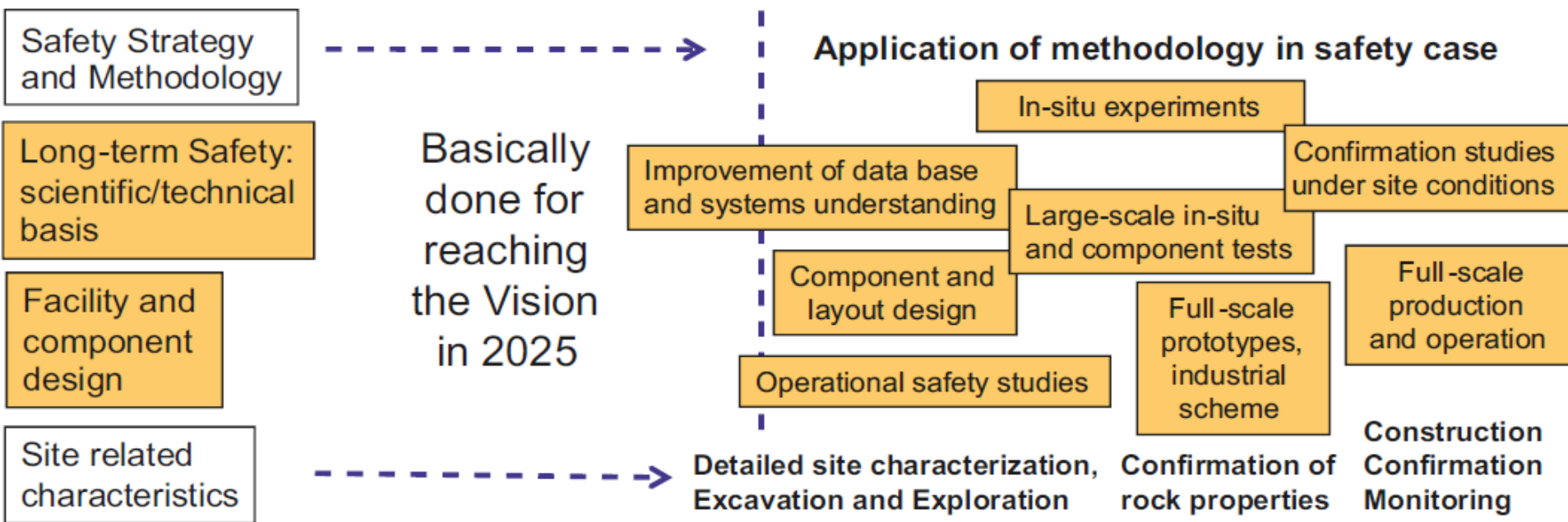
[ABOUT JOPRAD](#)[ACTIVITIES](#)[NEWS & EVENTS](#)[DOCUMENTS](#)[CONTACT](#)[USEFUL LINKS](#)[EXTRANET](#)

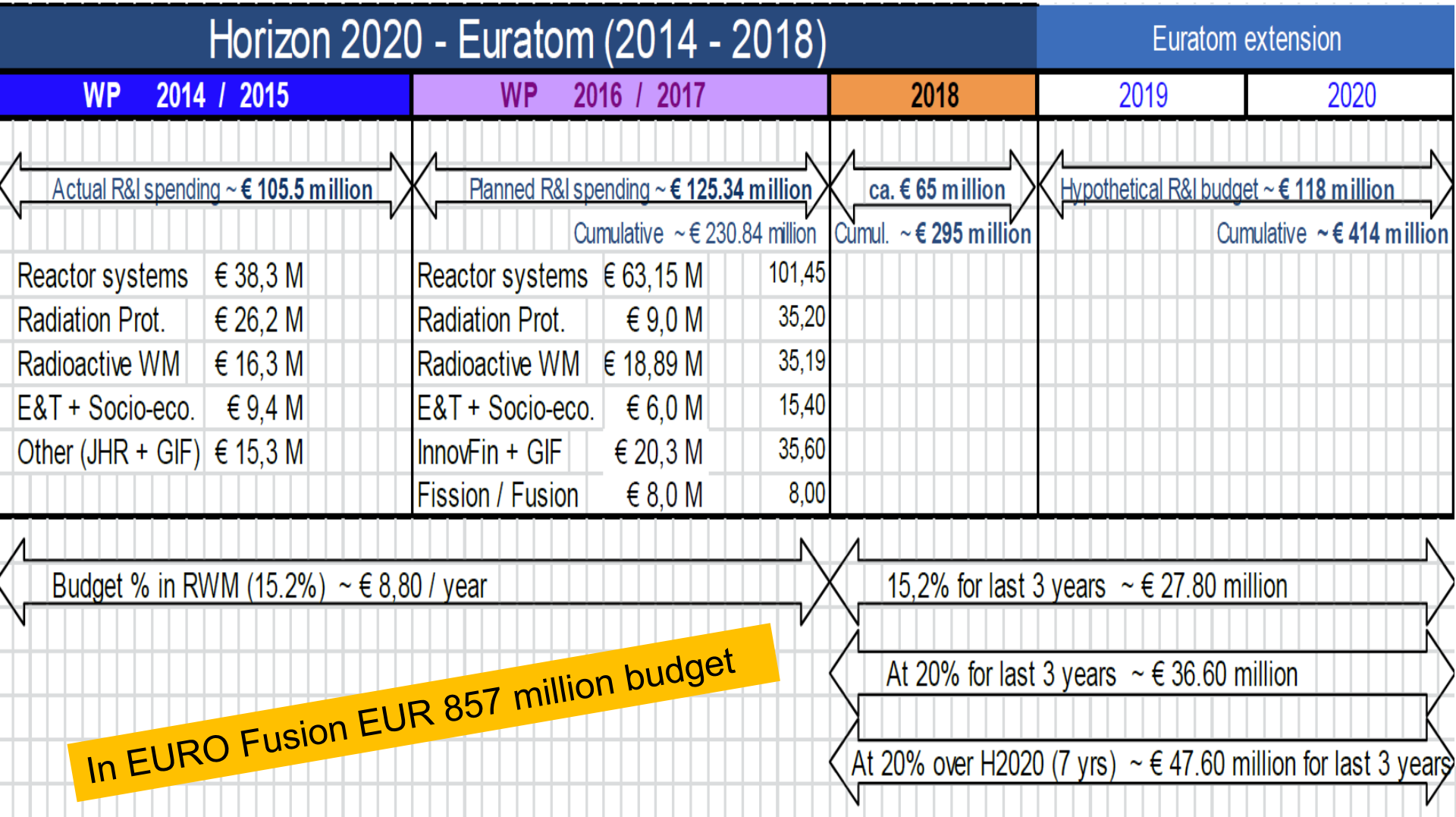
JOPRAD - Towards a Joint Programming on Radioactive Waste Disposal

> Develop synergies and increase coordination at EU
level

The Joint Programme will support the implementation of the Waste Directive ([2011/70/EURATOM](#)) in EU Member-States, taking into account the various stages of advancement of national programme.

STAGES →	Generic Studies	Site Selection	Development	Demonstration	Application
Technology	Conceptual Engineering	Host Rock and Site	Components Engineering	Components Testing	Industrial Scale Manufacturing
Repository	Conceptual Design		Repository Design	Repository Construction	Repository Operation







(Ministries / EU)



Proposer



1. Building Understanding - data, experiments, modelling, and testing:

- Inventory, Waste Form and Waste Characterisation
- Waste Package
- Consequences of Storage
- Near-Field and Engineered Barrier Systems
- Gas Generation and Transport
- Radionuclide and Chemical Species Transport
- Geosphere

STRATEGIC
THEMES



2. Building Confidence - tools, assessment and demonstration:

- Safety Case
- Post-Closure Processes and Upscaling
- Numerical Tools
- Operational Safety
- Practical Implementation

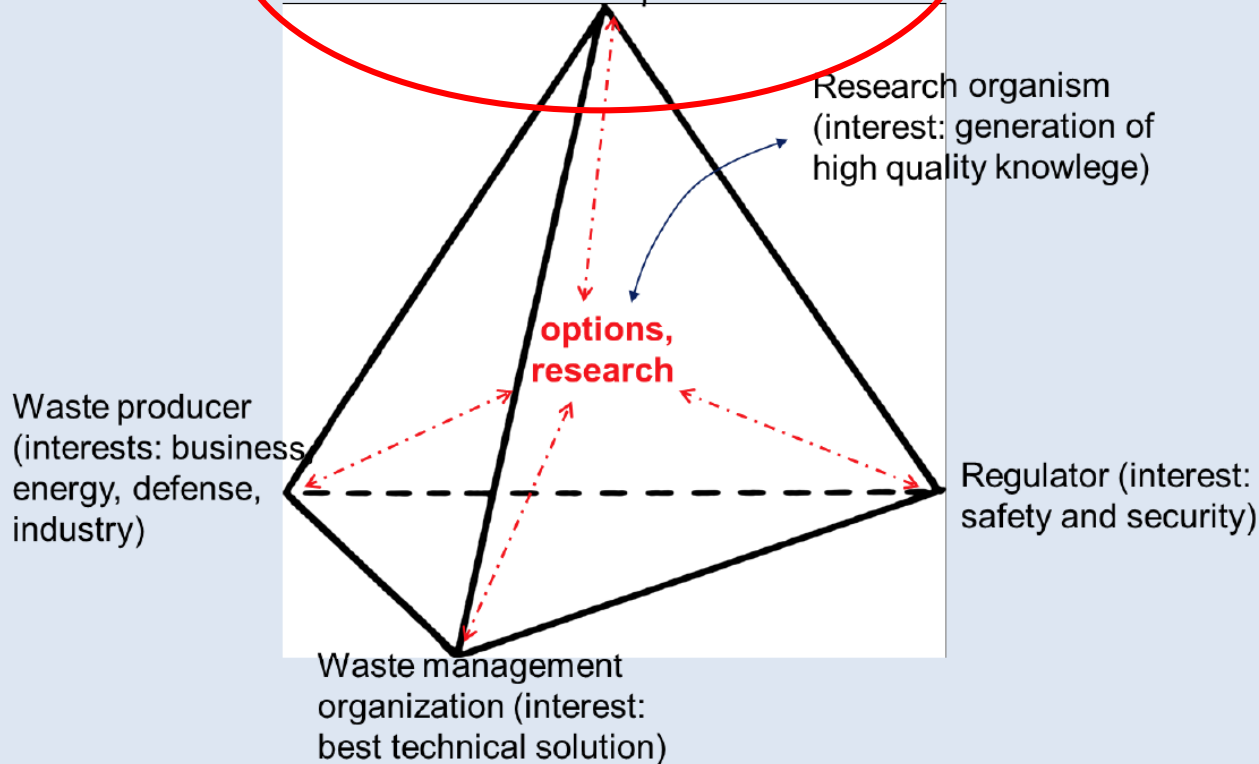
DOMAINS



3. Integrated Knowledge Management System

A schematic vision on separation and role of actors

General and local public interest:
parliamentary offices, government, regions
assure procedures, review, transparency
decisions of implementation



Ethical aspects

Burdens for future generations

How will moral concepts evolve?

Acceptance vs acceptability



1 Mio years

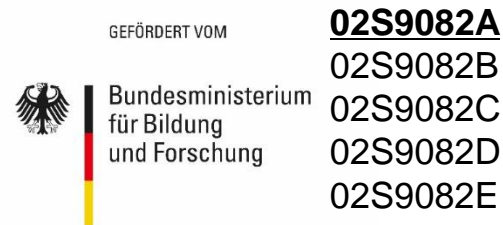
**Evolution of land use /
climate**

**Evolution of the
(technological) society ?**

Evolution of mankind?



13 universities and research centers (Germany, Switzerland)
70 scientists



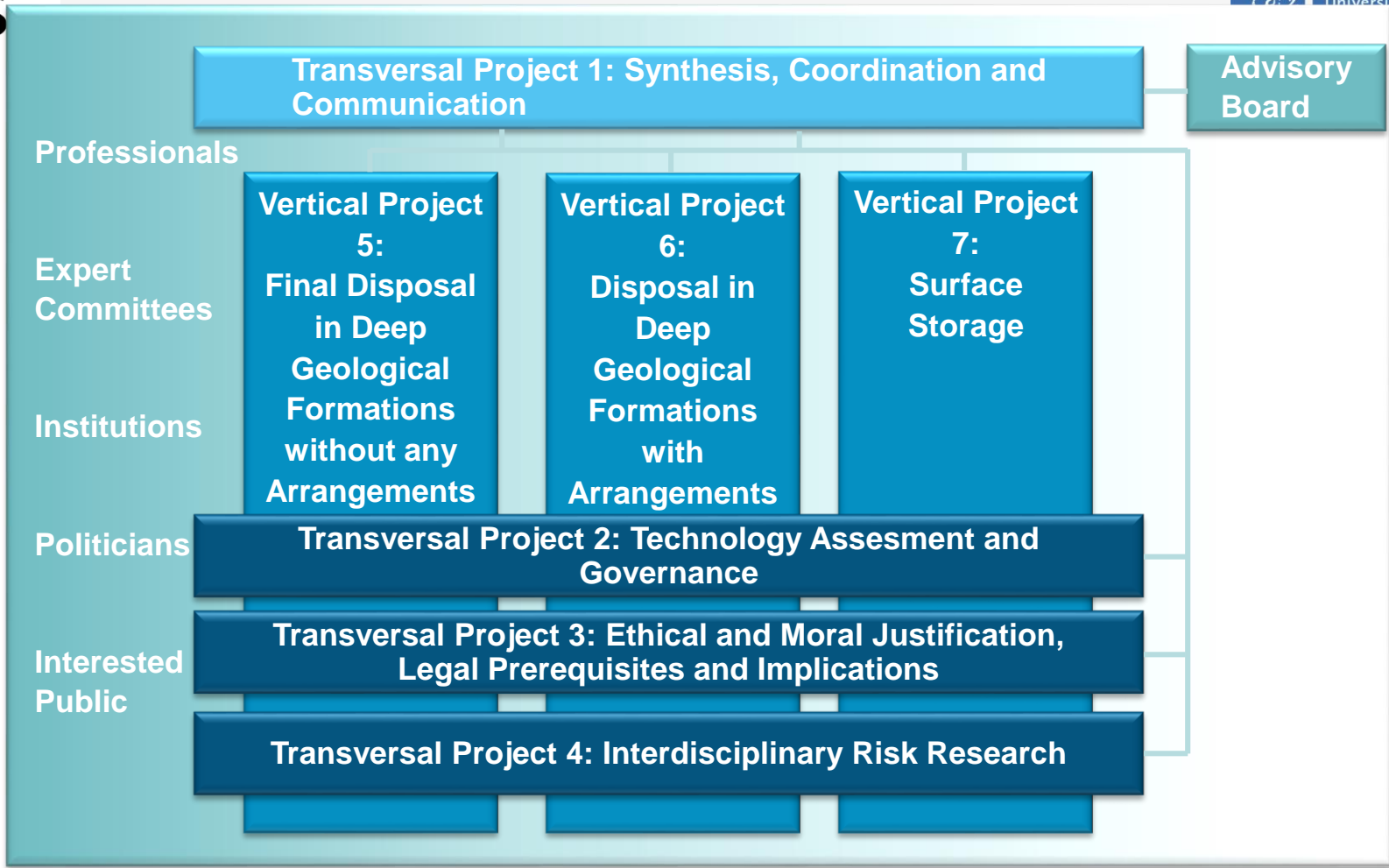
- 13 departments from German universities and national laboratories
one partner from Switzerland, 70 scientists

- Disciplines represented

- Physics
- Mathematics
- Chemistry
- Radiation Protection
- Geology
- Civil engineering
- Repository research
- Philosophy
- Law
- Social sciences
- Political sciences
- Technology assessment



- Project structure designed to foster interdisciplinarity



**Disposal of nuclear waste is a problem,
far beyond the technical aspect!**



Castor-Protest im Wendland am Wochenende: Trotz des Todesfalls wollen die Endlager-Gegner ihre Demonstrationen heute fortsetzen.



Ilis wollen die Endlager-Gegner ihre Demonstration