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Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Radioactive Waste Management in Germany – Recent Developments Based on Lessons Learnt

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MKG seminar

Stockholm, 3 June 2014

Agenda

1 Quick ride through German nuclear power history

2 Overview of nuclar waste amounts and facilities

3 Disposal of low and intermediate level waste

4 Management of spent fuel

5 A new start – the Repository Site Selection Act

6 Phase out chance and challenges

1. Quick ride through German nuclear power history

Nuclear power and research reactors

- Initial operation of first research reactors — 1957
- Initial operation of first commercial NPPs — 1960
- Latest start of operation, max. 20 NPPs in operation — 1988
- Nuclear-Phase-Out agreement („*Nuclear consensus*“) between Federal Government and electricity companies — 2000
- Amendment of Atomic Energy Act è “Nuclear Phase-out-Act”: restriction of average operational time: 32a, 2 NPPs permanently shut down — 2002
- Federal Government and Parliament decision on Extension of NPP operational time (average 40 years) — 2010

1. Quick ride through German nuclear power history

Nuclear power and research reactors

- Fukushima accident — 03-2011
- 8 reactors (8,4 MWe) permanently shut down — 07-2011
- 9 NPPs at 8 sites in operation, total capacity: 12,696 Mwe
  staged phase out by 2022 legally fixed — Today

- New built of NPPs was and is prohibited since the 2002 “Nuclear Phase-Out Law”

1. Quick ride through German nuclear power history

Nuclear power plants and prototype reactors after Fukushima accident

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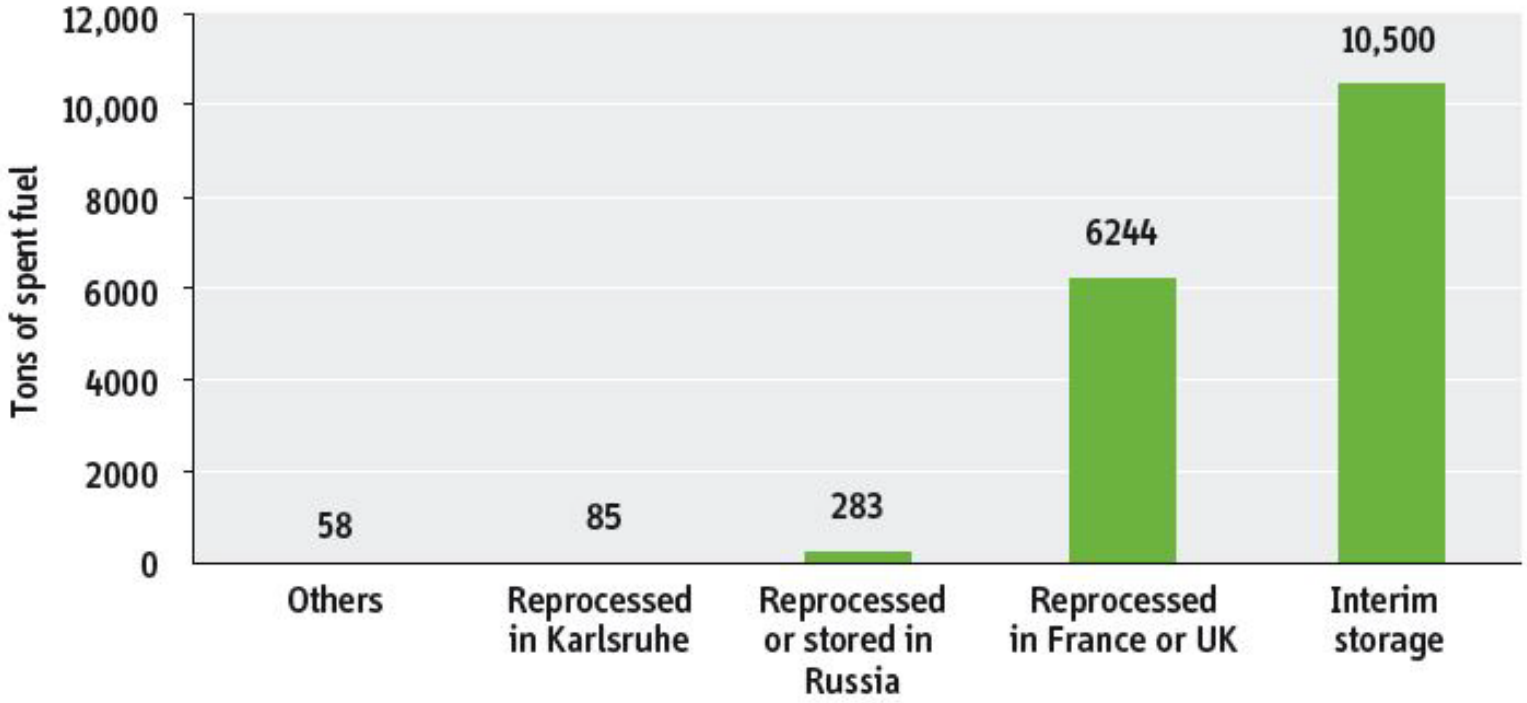
2. Overview of nuclar waste amounts and facilities

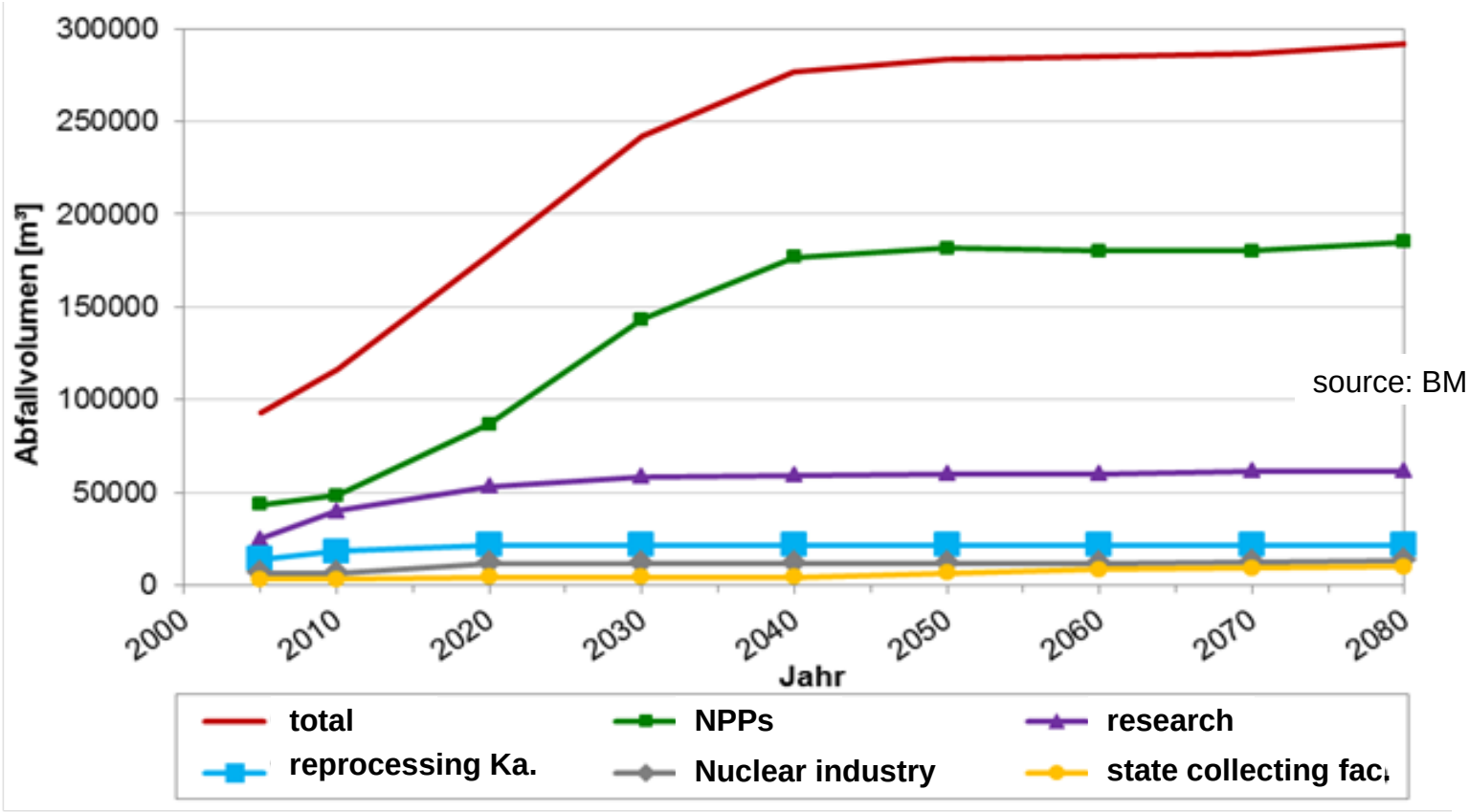
Amounts of waste from spent nuclear fuel by 2022



- about 2,500 t of spent fuel in interim storage to arise between 2013 and 2022

2. Overview of nuclar waste amounts and facilities

Development of waste amounts with negligible heat generation



source: BMU 2011

not considering waste amounts disposed of at Asse and Morsleben sites

2. Overview of nuclar waste amounts and facilities

- Onsite interim storage for spent fuel (SF)
- Offsite storage for SF
- SF storage pool
- Waste interim storage and state collecting facility
- Conditioning facility
- Waste repository
- Waste retrieval project Asse
- Former exploration mine Gorleben

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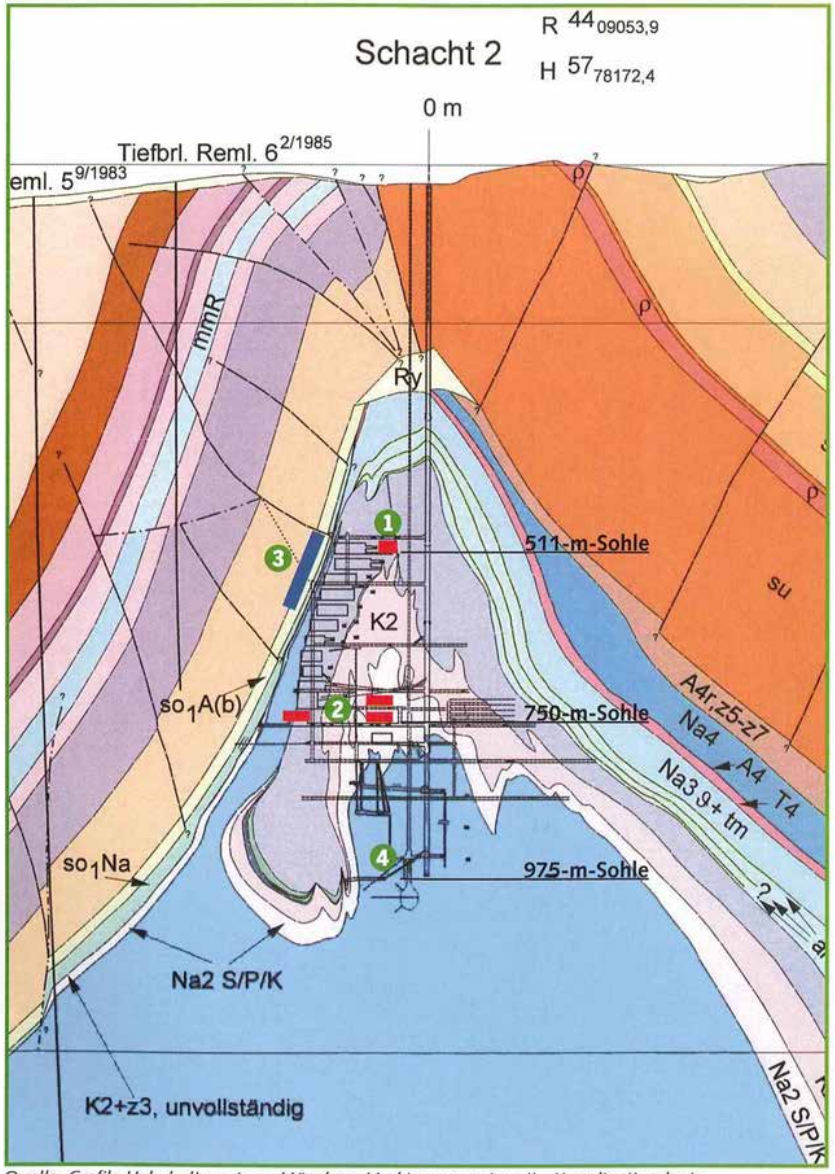
3. Disposal of low and intermediate level waste

Schacht Konrad repository under construction

Morsleben
LAW/MAW repository
closure ongoing

Asse (former „research mine“): investigations for waste retrieval ongoing

3.a Experience and problems of the Asse repository



Quelle: Grafik: Helmholtzzentrum München; Markierungen: Asse II - Koordinationskreis

Geological situation

- Zechstein salt dome
- From 1909 till 1964 salt mine for potash salt and rock salt

1. MAW chamber:
   1 chamber 511 m level
   1293 barrels intermediate active waste
2. LAW chambers:
   1 chamber 725 m level
   11 chambers 750 m level
   124.494 barrels low-level waste
3. brine inflow from overlying rock (about 12 m³/day since 1988)

3.a Experience and problems of the Asse repository

Waste disposal

- Waste disposal from 1967 – 1978
- Nominally for research purposes, but: no intention of waste retrieval

Safety problems

- brine inflow
- instability
- danger of flooding and collapse due to salt dissolution

è release of radionuclides è contamination of groundwater and biosphere

3.a Experience and problems of the Asse repository

Contributing factors

- Asse mine
  - was never intended to be used for disposal purposes,
  - was excavated close to the outer boundary of the salt dome,
  - chambers from salt exploration not backfilled before waste emplacement.
- Science, industry and politics

  è prove feasibility of disposal

  è suitability of the mine not questioned
- Cheap “solution” of final waste management
- insufficient realisation of checks and balances
  - unsuitable distribution of roles
  - realisation under mining law è nuclear requirements ignored
- no involvement of the public è early warnings ignored

3.a Experience and problems of the Asse repository

2009 Federal Office for Radiation Protection, BfS, new operator

2010 BfS - supported by the regional representatives - choosing retrieval as the preferred option for closure

2011 3-phased feasibility study started

2012 first drilling into closed waste chamber failed, second attempt successfully terminated in June 2013

in parallel: Measures to increase stability of the mine and to extend the potential time for future actions

2033 Start of retrieval not expected before 2033

expected volume: 200,000 – 400,000 m³

3.b Schacht Konrad: repository under construction

Disposal of “Waste with Negligible Heat Generation”

A former iron ore mine in Lower Saxony
Accepted volume: 303,000 m³
Emplacement drifts at 800 – 1300 m depth

3.b Schacht Konrad: repository under construction

- Application for plan approval filed in 1982
- Public hearing - part of the plan approval procedure - held in 1992
  - Duration: 75 days - the longest in German nuclear instatallations history .
  - About 290.000 objections had to be treated
- The plan approval notification was served in May 2002
- Complaints at the Lüneburg Supreme Administrative Court and the Federal Administrative Court were decided or in the latter case rejected in 2006 and 2007
- Detailed planning and reconstruction works are ongoing since 2007
- Start of operation is expected around 2015 – 2019 – 2022
  è 7 years delay in the last 4 years

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4. Management of spent fuel

Short overview

- Reprocessing (France and UK) as well as interim storage at centralized storage facility used till 2002 “Nuclear Phase Out Law”
- Onsite interim storage of spent fuel mandatory today
- Interim storage of HLW from reprocessing at centralized cask storage facility Gorleben è return-shipments of vitrified waste still ongoing, but alternatives to Gorleben foreseen
- Exploration activities for disposal of high active waste and spent fuel have focused on the Gorleben salt dome since the late 1970s
- Attempts for starting a new site selection process failed in the past till 2011

4.a Management of spent fuel – Interim Storage

Interim Storage

- 2000: “Nuclear Consensus” of Government and electricity companies comprised agreements on erection of on site interim storage facilities at each reactor site
- Planning, licensing and construction of 12 storage facilities was done in about 8 years between 1998 and 2006
- Capacities adapted to the expected amounts of spent fuel and a clear restrictions of operating times were points of major interest in for regional representatives and public
- The technical concept is based on the storage of robust dual purpose casks in storage buildings with passive air cooling
- Licenses are limited to 40 years è A stable factor in German nuclear waste management policy, but: Follow up unclear when no repository is available in time when licenses expire

4.b Gorleben Exploration Mine

- 1977: The Gorleben site was defined for exploration for a repository for all kinds of radioactive waste (later changed to “heat generating waste”)
- 1979: Above ground explorations were started
- 1986: Underground explorations were started with the sinking of two shafts to a depth of 800 m
- 1995: the driving of horizontal drifts began. The two shafts were connected in 1996
- From today’s perspective the selection of Gorleben is not sufficiently transparent
- An exploration moratorium for longest 10 years for clarification of basic questions was decided in 2000 due to ongoing discourse on suitability of the site. The moratorium ended (under new Government) in October 2010

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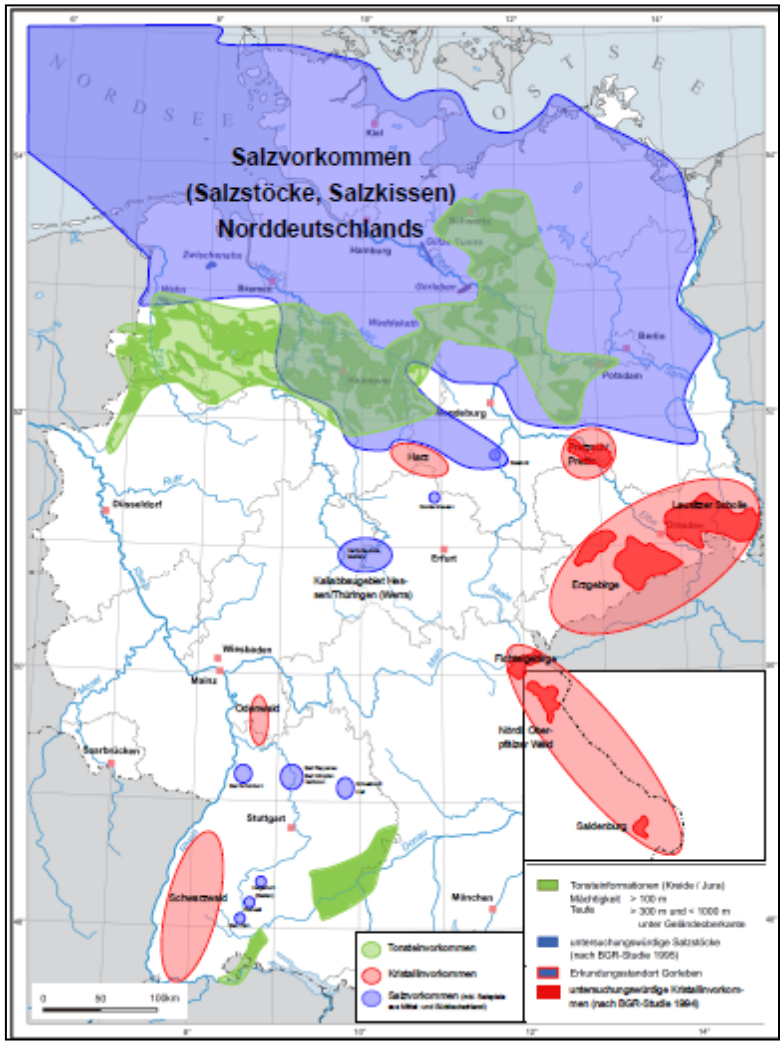
5. A new start – Repository Site Selection Act

New Majorities after the Fukushima accident:

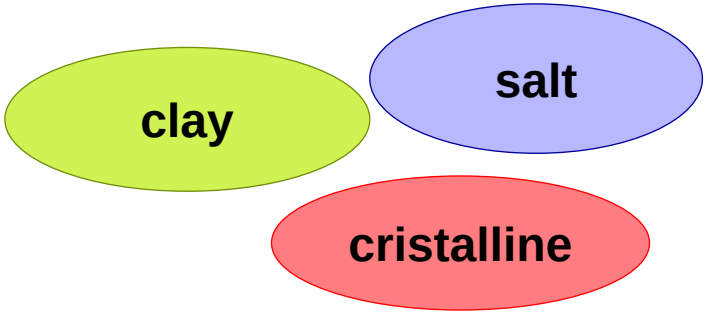
- Broad political and societal support for nuclear phase-out decision
- New societal and political openness for solving the waste management problem
- Proof of changed demands on decision-making processes ("Stuttgart 21")
- New political majorities on the Länder level
- Growing public scepticism in the salt concept (failure of the Asse project) …

Political agreement on Federal and Länder level to restart siting based on the "Repository Site Selection Act (passed July 2013)

5. A new start – Repository Site Selection Act



Enhanced geological and geographical diversity:

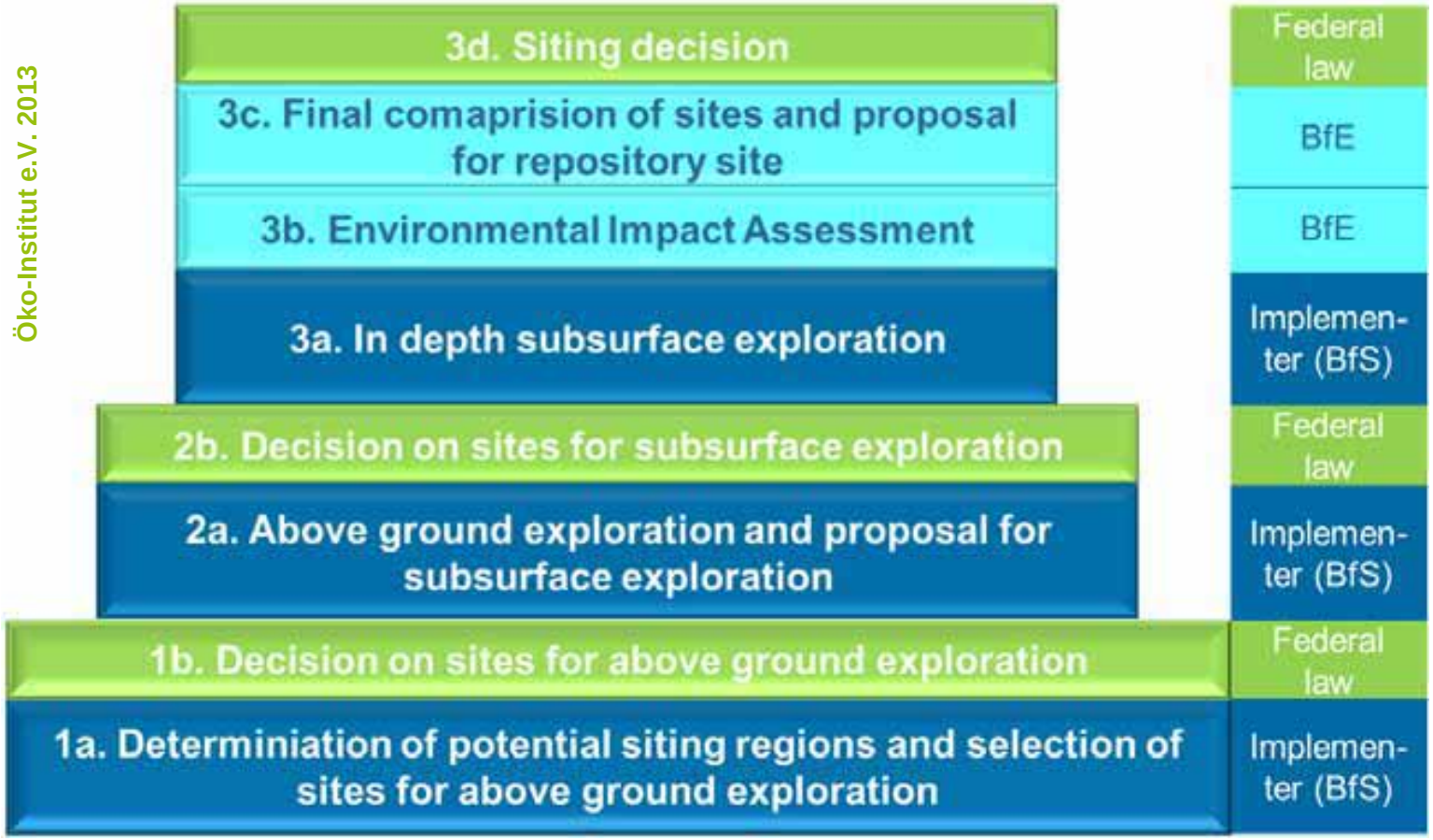


to be considered as potential host rocks

Stop of Gorleben explorations

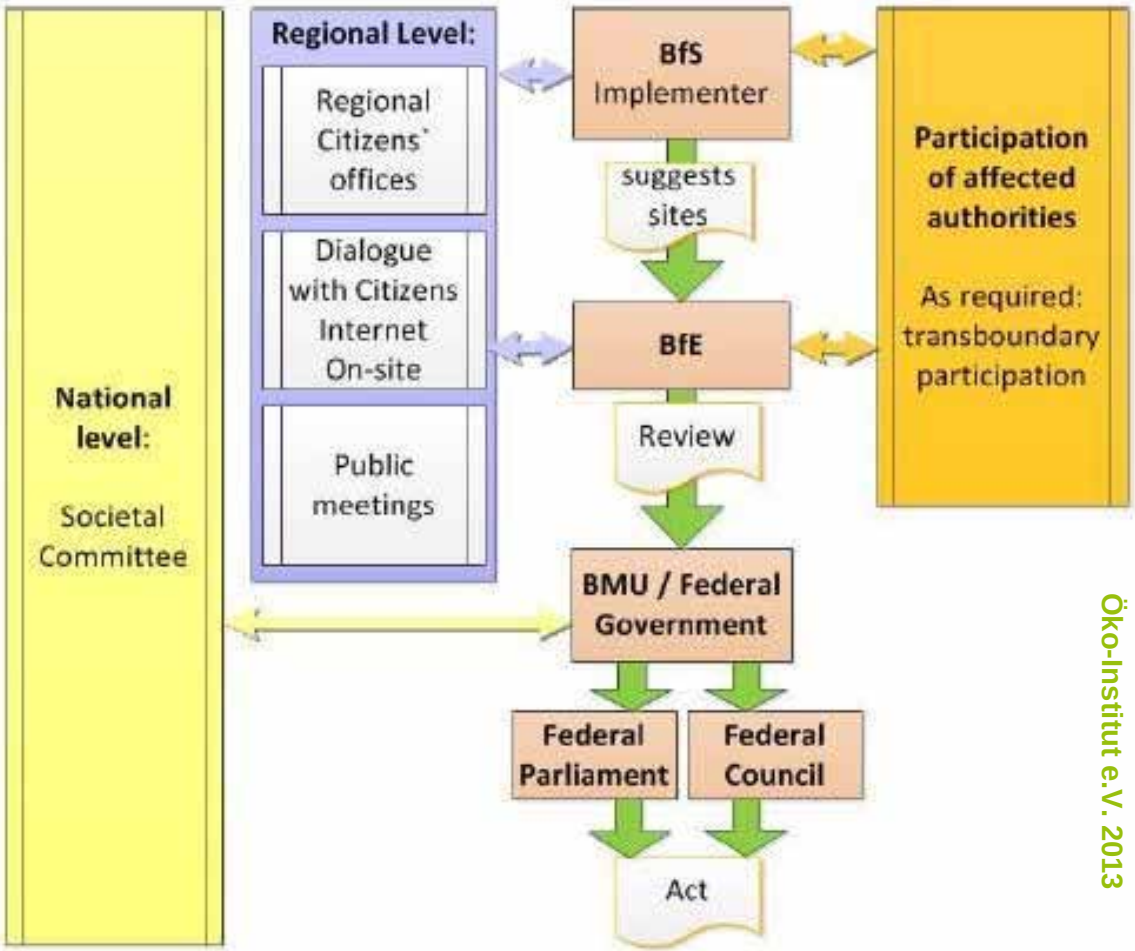
5. A new start – Repository Site Selection Act

Stepwise siting process



5. A new start – Repository Site Selection Act

New players and broad participation



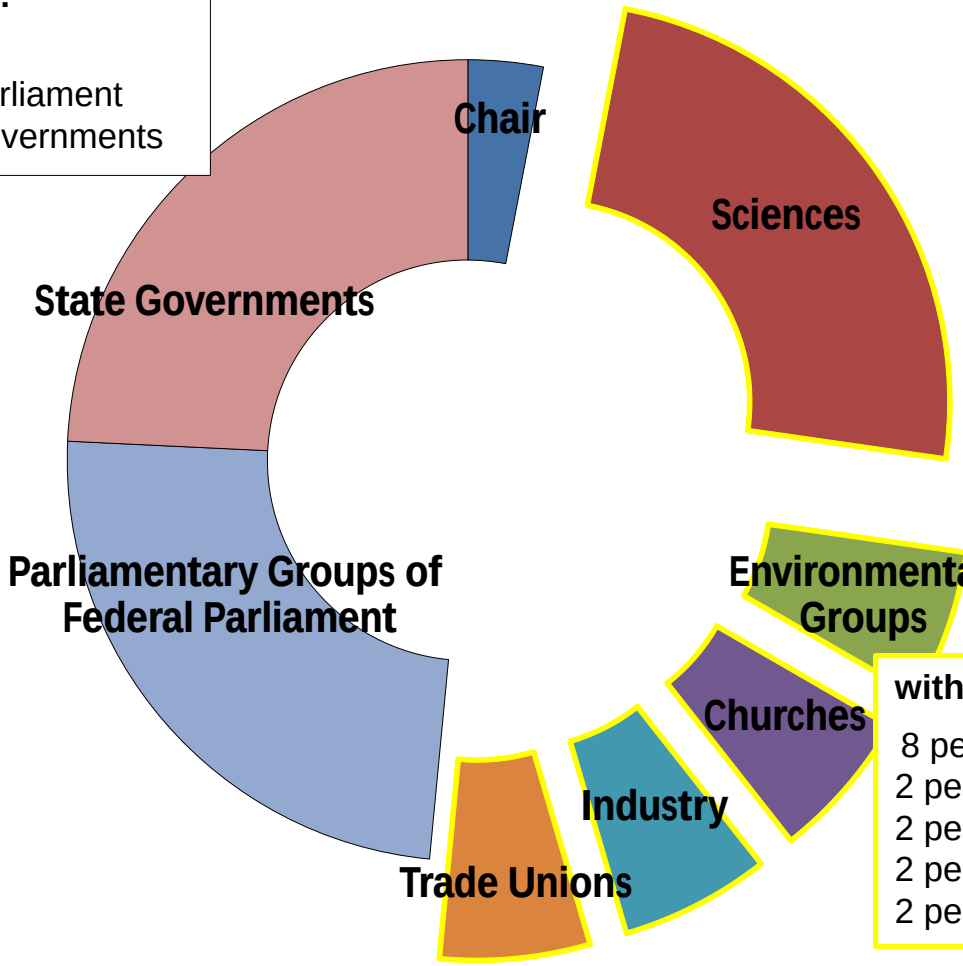
5. A new start – Repository Site Selection Act

Kommission Lagerung hoch radioaktiver Abfallstoffe

Commission for High Level Waste Disposal

without voting rights:

2 Chair Persons
8 Members of Fed. Parliament
8 Members of state governments



with voting rights:

8 people: Sciences
2 people: Environmental Groups
2 people: Chruches
2 people: Industry
2 people: Trade Unions

5. A new start – Repository Site Selection Act

Commission for High Level Waste Disposal

Tasks, to be finalised by end 2015:

- review waste management options
- review the Act
- provide detailed recommendations on: selection criteria, selection process, participation

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6 Phase out chances and challenges

6. Phase out chances and challenges

…from a waste management perspective

- Well known waste amounts for spent fuel and operational waste
- Clear time schedule of spent fuel and waste generation from decommissioning
- New political and societal openness for solving the spent fuel management problem
- Opening an exit from the Gorleben dilemma to a restart of siting a high active waste repository

6. Phase out chances and challenges

…from a waste management perspective

- Delays in completion of Konrad repository cause additional challenges for management of decommissioning waste
- High societal resistance against onsite waste storage facilities

- Economical challenges of dismantling and waste management in times of decreasing profits become apparent
- New governance models needed for controlled termination of the nuclear age?

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Thank you for your attention!

Do you have any questions?

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