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

Nuclear waste management in Germany (compared to Denmark)

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International conference on the radioactive waste in Denmark
Copenhagen, 24 March 2015

Agenda

1 Overview of nuclear waste amounts and facilities in Germany

2 Disposal of low and intermediate level waste

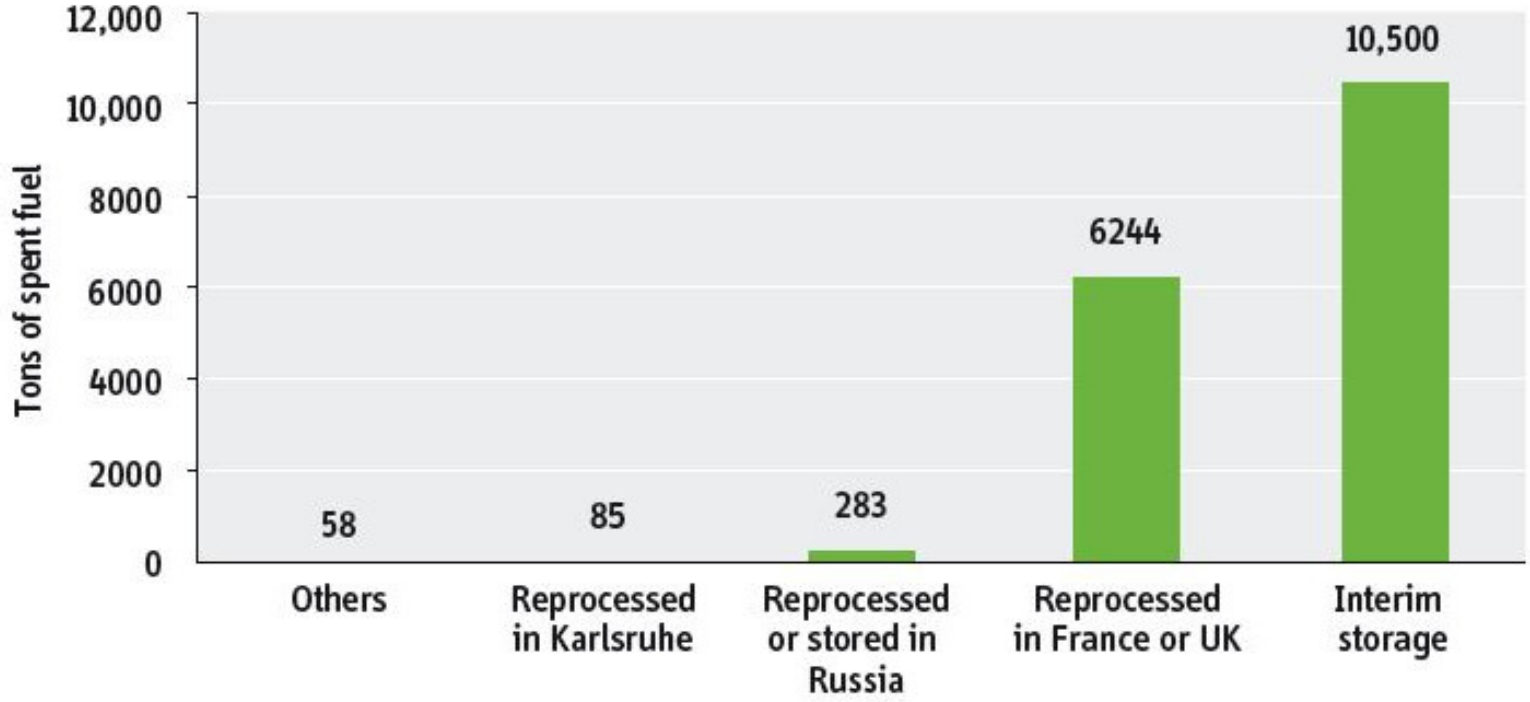
3 Management of spent fuel from nuclear power plants

4 A new start – the Repository Site Selection Act

5 Some final thoughts

1. Overview of nuclar waste amounts and facilities in Germany

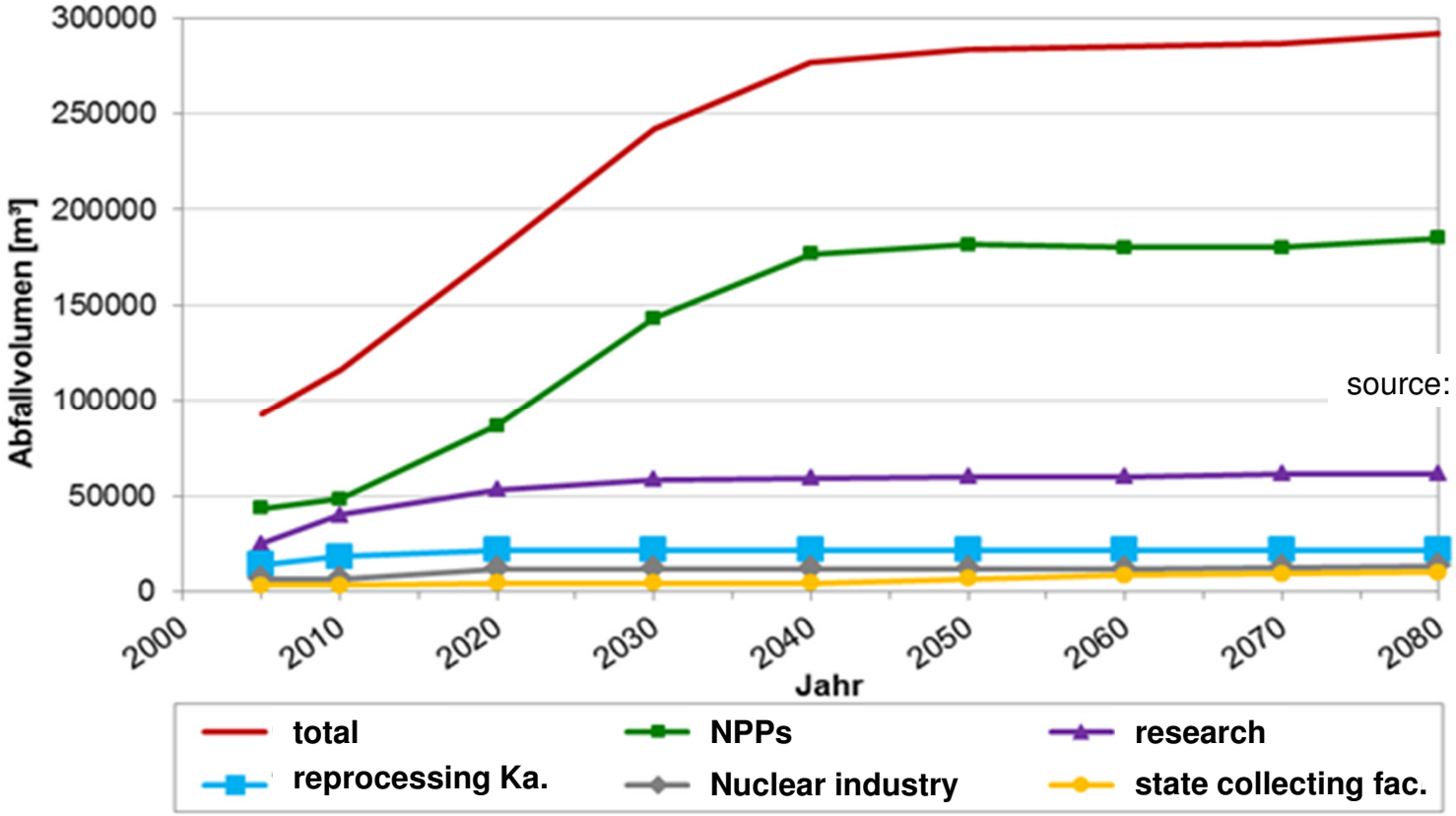
Amounts of waste from spent nuclear fuel by 2022



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

1. Overview of nuclar waste amounts and facilities in Germany

Development of waste amounts with negligible heat generation



source: BMU 2011

not considering waste amounts disposed of at Asse and Morsleben sites

1. Overview of nuclar waste amounts and facilities in Germany

- 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

1. Overview of nuclar waste amounts and facilities in Germany - Comparison

- Amounts of waste in Germany much bigger than in Denmark
- Relevant share of spent fuel from nuclear power plants and vitrified high level waste from reprocessing with very high activity and long lived radionuclides
- Due to the disposal concept Germany uses waste classification system different from the IAEA system used in Denmark and other countries:

German classification	Rough correspondence in IAEA system
Heat generating waste	high level radioactive waste
Waste with negligible heat generation	low and intermediate level radioactive waste (independent of its longevity)

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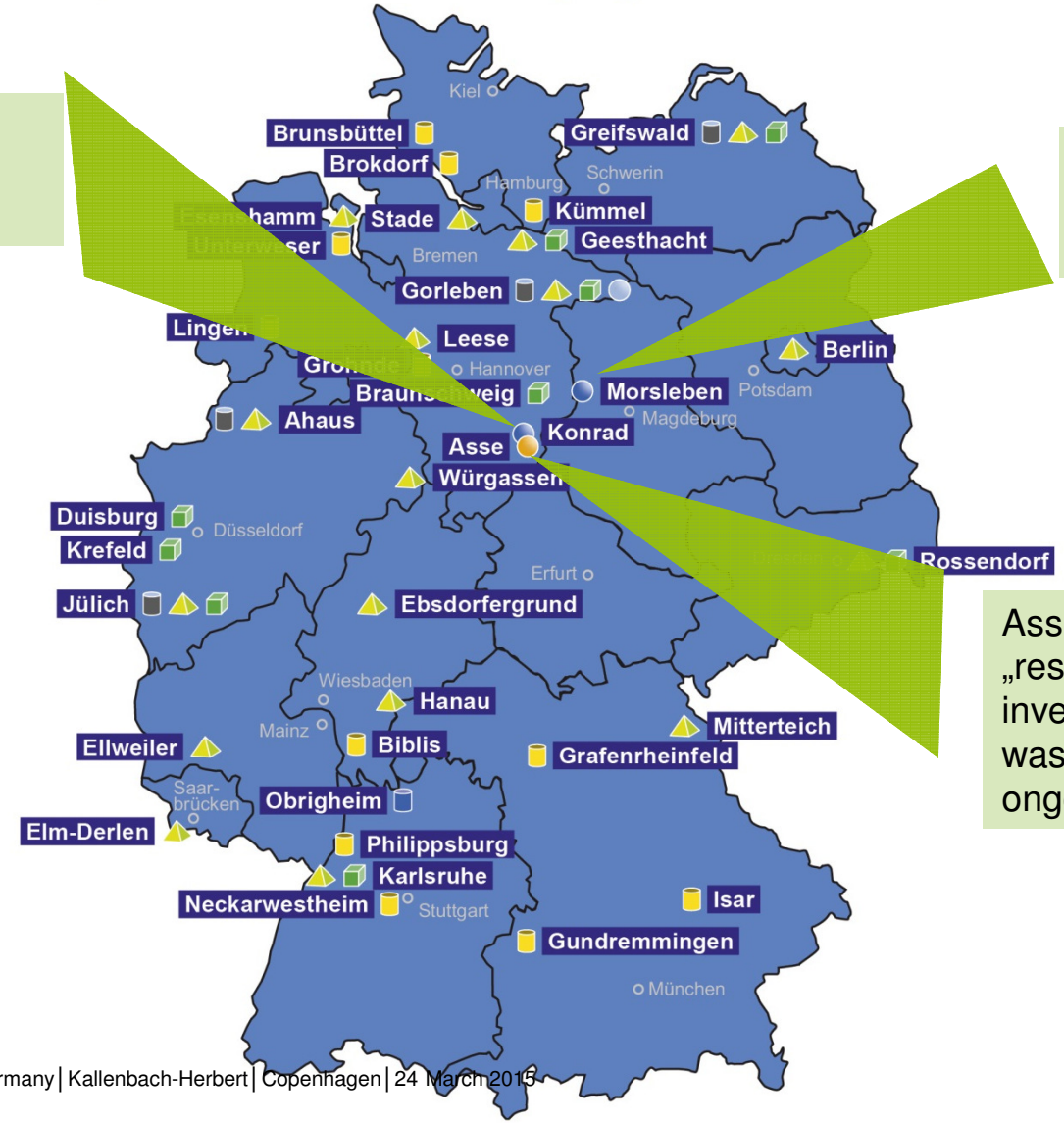
2. Disposal of waste with negligible heat generation

Schacht Konrad repository under construction



Morsleben LAW/MAW repository closure ongoing

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

2.a Schacht Konrad: repository under construction

Disposal of “Waste with Negligible Heat Generation”

- Former iron ore mine
- Application for plan approval for disposal of 303,000 m³ filed in 1982
- Public hearing - part of the plan approval procedure - held in 1992
  - Duration: 75 days - the longest in German nuclear installations 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
  ➔ 7 years delay in the last 4 years

2.a Schacht Konrad: repository under construction

Geological situation at the Schacht Konrad repository

- Host-rock for disposal chambers (800-1300 m depth):
  iron-ore containing rock layers, ‚Malm‘
  (clayey limstone, marly clay, …)
- Covered by 400 m thick clay layer – very low permeability to water
- ➔ No hydraulically effective connection of the repository to the groundwater near the surface

2.a Schacht Konrad: repository under construction

Hydrogeological situation at the Schacht Konrad repository

- Based on model calculations by the implementer BfS:
  - The migration time of fossil waters (and radionuclides) to the surface is estimated to exceed 300,000 years
  - The transport of long-lived radionuclides with a higher retention level in the geosphere takes a lot longer (several million years)

2. Disposal of waste with negligible heat generation - Comparison

- Based on first impressions of the Danish conceptual reports

Germany	Denmark
Early decision in Germany to apply deep geological disposal to all kinds of nuclear waste above clearance level	**Potential** distinction of disposal concepts for long lived and short lived waste in Denmark
One set of acceptance criteria for all types of waste with negligible heat generation	
High relevance of ground water protection	High relevance of ground water protection

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3. Management of spent fuel – Interim storage

- 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

3. Management of spent fuel – Gorleben exploration

- Exploration activities for disposal of high active waste and spent fuel have focused on the Gorleben salt dome since the late 1970s
- 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
- Exploration moratorium from 2000 – 2010 due to ongoing discourse on suitability of the site
- Attempts for starting a new site selection process failed in the past
- Political and societal openness to restart a siting process since nuclear phase out decision after Fukushima accident in 2011
- End of exploration activities in 2013 due to start of a new siting procedure

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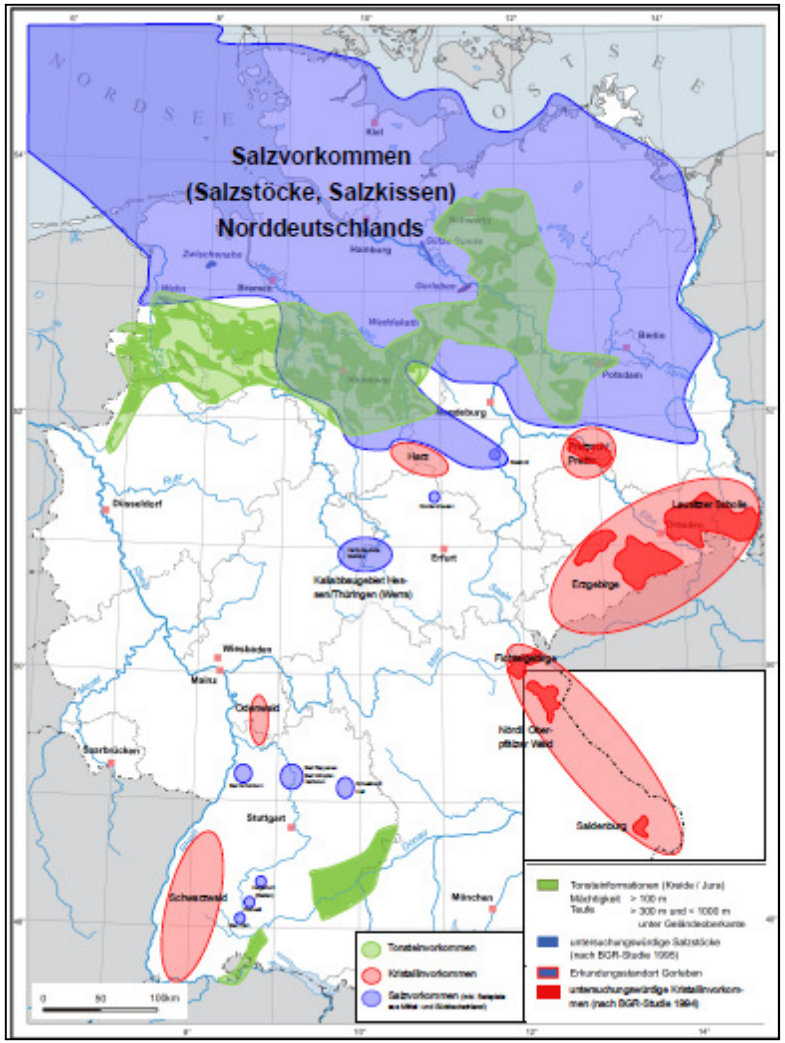
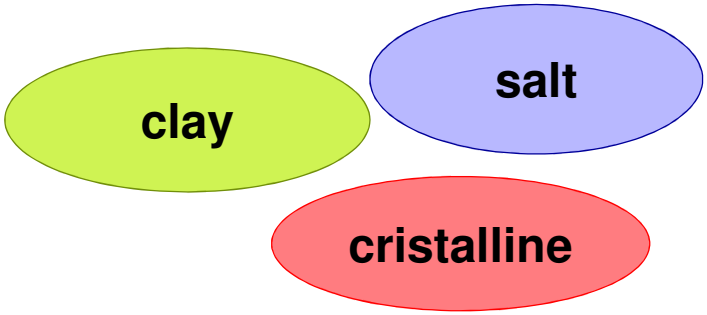
4. A new start – Repository Site Selection Act (2013)



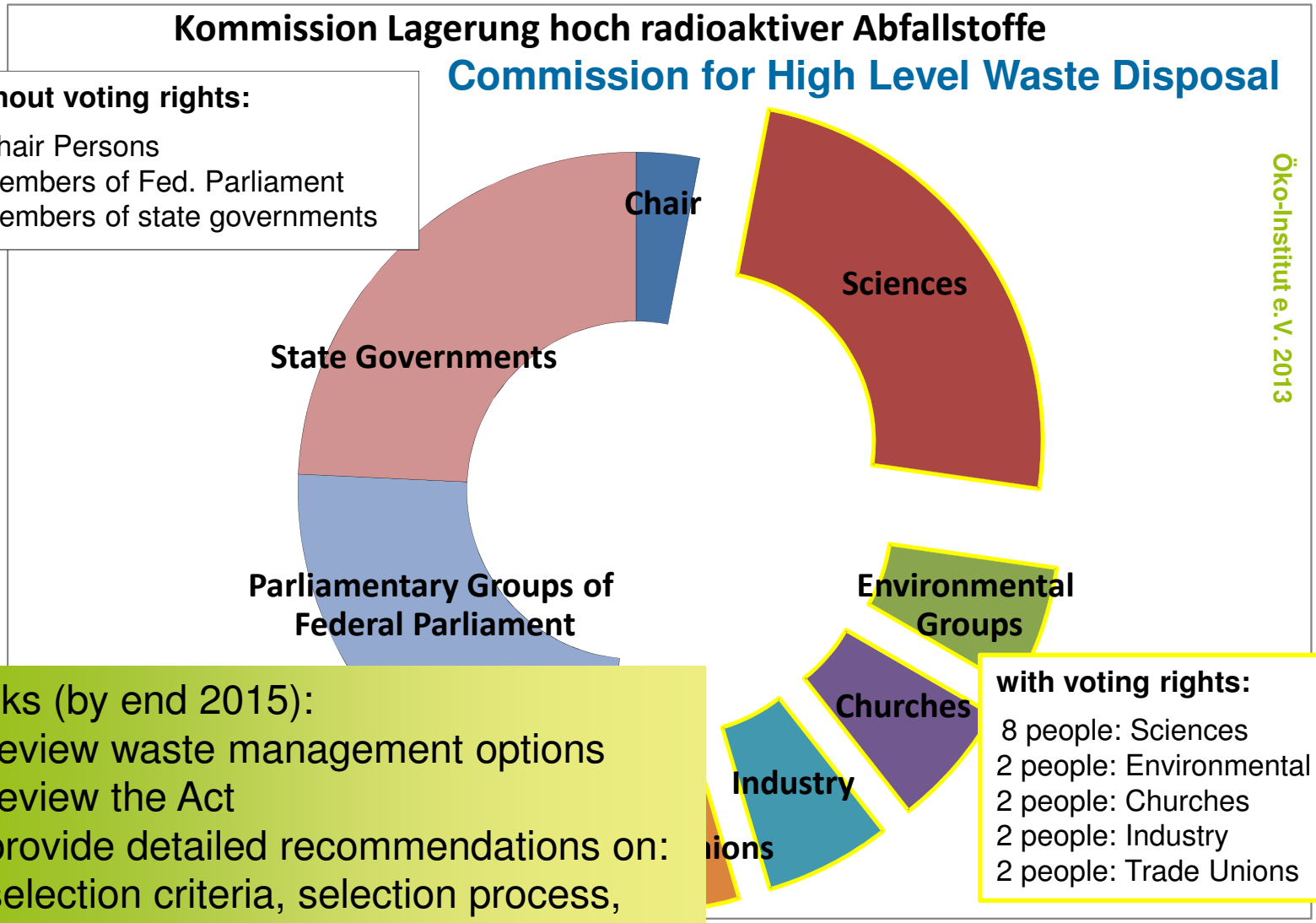
Enhanced geological and geographical diversity:



to be considered as potential host rocks

Stop of Gorleben explorations

4. A new start – Repository Site Selection Act (2013)

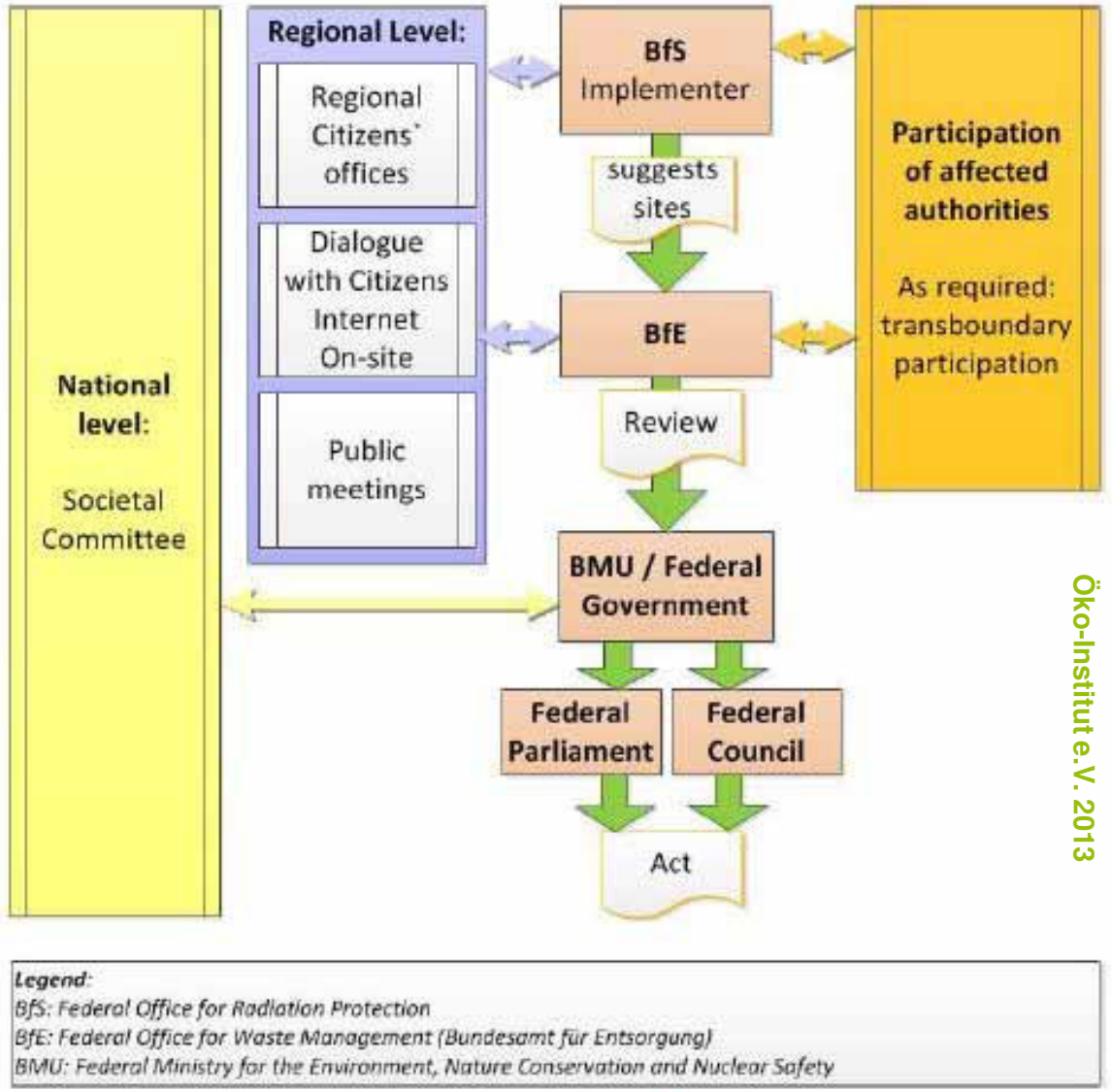


Tasks (by end 2015):

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

4. A new start – Repository Site Selection Act (2013)

New players and broad participation



4. A new start – Repository Site Selection Act (2013)

Stepwise siting process

4.a Recommendations of the AkEnd

…a basis for site selection was laid by the AkEnd in 2002:

Relevant effects of geological and geophysical processes on a repository with its barrier system were considered:

- Erosion of the geological formations with denudation of the repository
- Reduction of the geological barrier
- Changing of groundwater conditions
- Creation of flow paths by geological faults and fractures
- Gas/brine entering the repository
- Magmas entering the repository
- Covering by surface water

4.a Recommendations of the AkEnd

AkEnd's **exemption criteria**:

- The repository area must not show **large-area uplifts** of more than one millimeter per year on average during the predictable period.
- There must not be any **active fault zones** in the repository area
- In the repository area, the **seismic activities** to be expected must not exceed Earthquake Zone 1 according to DIN 4149.
- In the repository area, there must neither be any quaternary nor any expected future **volcanism**.
- The isolating rock zone **must not contain any young groundwate**r. Thus the groundwater must contain no tritium and/or carbon-14.

4.a Recommendations of the AkEnd

AkEnd's **minimum requirements**:

- The isolating rock zone must consist of rock types to which a field hydraulic conductivity of less than 10^{-10} m/s can be assigned
- The thickness of the isolating rock zone must be at least 100 m
- The depth of the top of the required isolating rock zone must be at least 300 m
- The repository mine must lie no deeper than 1,500 m.
- The isolating rock zone must have an areal extension that permits the realisation of a repository (e. g. approximately 3 km^2 in salt or 10 km^2 in clay or granite)
- Neither the isolating rock zone nor the host rock must be at risk from rock burst
- There must be no findings or data which give rise to doubts whether the geoscientific minimum requirements regarding field hydraulic conductivity, thickness and extent of the isolating rock zone can be fulfilled over a period of time in the order of magnitude of one million years

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Denmark	Germany
• Small amounts of waste	• Comparably big amounts of nuclear waste, including shares of old waste packages == > realising geological repository for LILW highly important
• Limited political and societal discourse on nuclear waste management (national) • Rising debate in affected regions (?)	• Radioactive waste disposal = a highly controversial subject in Germany; • Different disposal projects sum up to long history of success and failures • Building trust is a big challenge
• Conceptual developments for repository design and governance procedure on the way	• Planning process for HAW repository ongoing: high relevance of (quantitative) siting criteria and governance structures including stakeholder participation

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Thank you for your attention!

Do you have any questions?

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