WISMUT

1991–2011

Experience from the WISMUT Project with the Management of Large Volumes of Radioactive Residues

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Vienna, Austria, 28 January - 1 February 2013

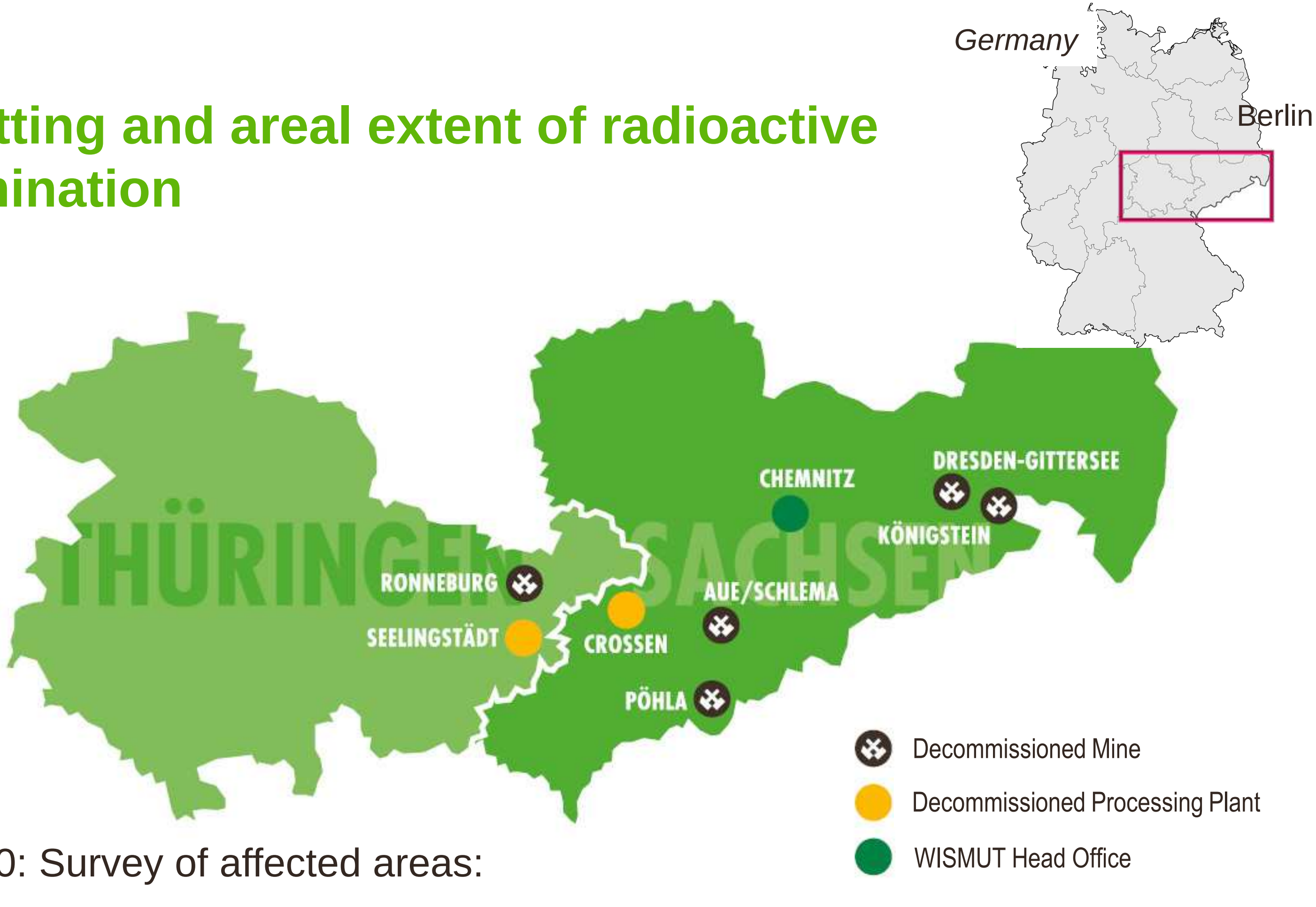
Presentation Outline

- Background
- Remediation approach and technologies
- A case study
- After use
- Lessons learned & Summary

Background

- 1946 - 1990, SDAG Wismut in East Germany major uranium supplier to the Soviet Union (~ 216,000 tonnes of U)
- 1990, U production terminated in the wake of the German reunification, start of remediation
- German government earmarked 6.6 billion Euro to fund the remediation project.
- Mining and milling affected approximately 100 km^2 in densely populated areas.

Site setting and areal extent of radioactive contamination



- 1990: Survey of affected areas:
  - 85 % of territory released for unrestricted use (dose rates < 200 nSv/h)
  - Delineation of areas providing main radioactive impact, focus on **3,700 ha** operational areas at 5 mine & 2 processing sites

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Remediation goals

- **Ensure public safety**, physical/chemical stability of all remaining structures/objects
- **Enable future land use**
- **Minimize radiation risks** and hazards
  - Achieve individual effective dose for public: <1 mSv/a (action level and remediation goal)
- **Reduce adverse effects** to water resources
- **Destigmatize** regions, affected by uranium mining

Wismut Programme: Main Technologies

Comprises full scope of mine remediation, amongst others:

- Dismantling of surface structures, removal of contaminated material and safe disposal
- Safekeeping of waste (tailings, waste rock)
- Effluent treatment




Radioactive residues

- **Waste rock, Low grade ore:** 325 Mm^3 ; 60^+ objects (dumps), 0.2...2 Bq/g ^{226}Ra
- **Tailings :** 160 Mm^3; 600 ha, 7 objects (ponds), 10 Bq/g ^{226}Ra
- **Material from area clean-up ***
  - Debris/concrete (865,000 m^3 ; 0,2…1 Bq/g ^{226}Ra)
  - Contaminated Soil, waste rock (14.5 Mm^3)
  - Scrap metal (200,000 t; 0,5…50 Bq/cm^2 α-activity)
- **Water treatment residues**





* Ref.: Wismut GmbH, Sanierungsprogramm 20

Safekeeping of mine waste

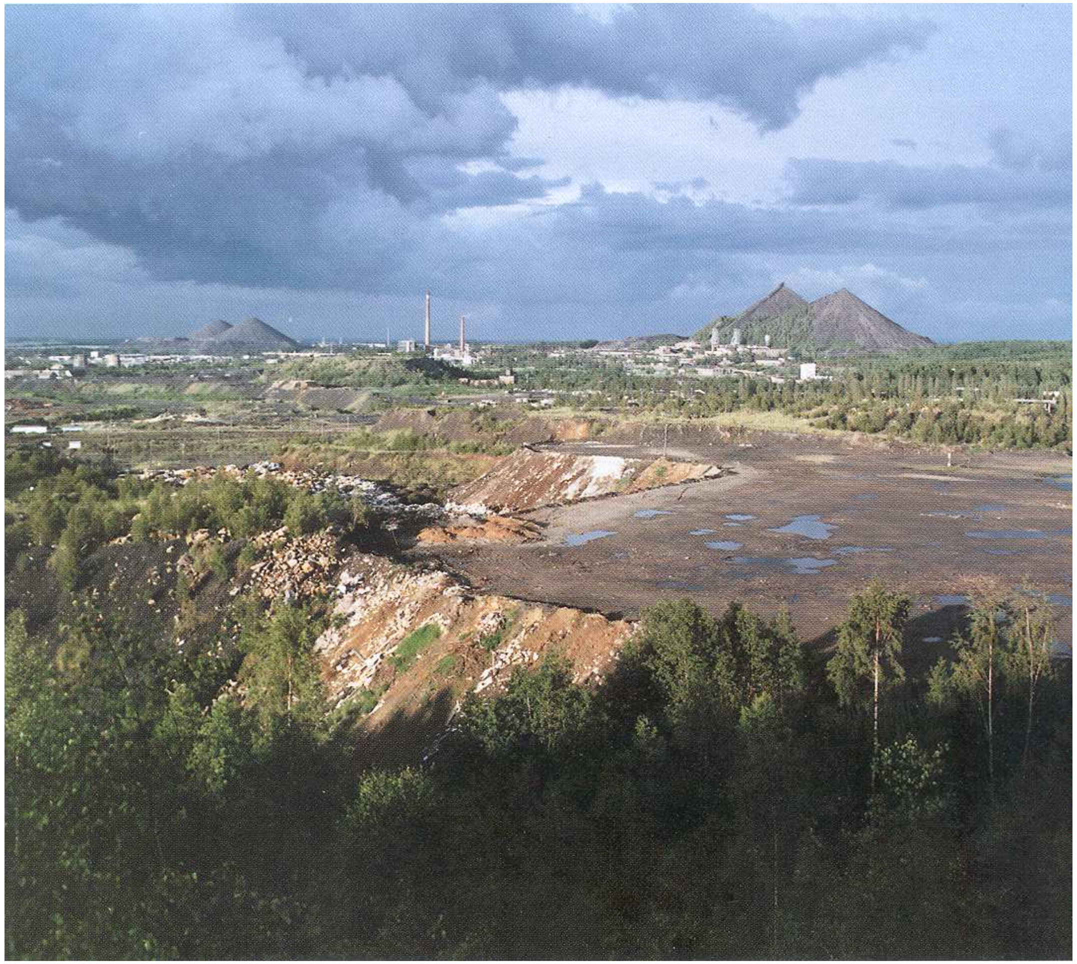
Site	Waste rock (Mm^3)	Main remediation technology	Tailings (Mm^3)	Main remediation technology	Main waste disposal area for other residues
Aue/Schlema	46	In-situ	0.3	In-situ	WD #371
Ronneburg	211	Relocation	-	-	Lichtenberg OP
Seelingstädt	55	Integrated	107	In-situ	Culmitzsch TMF
Crossen	3*	Relocation	54	In-situ	Helmsdorf TMF

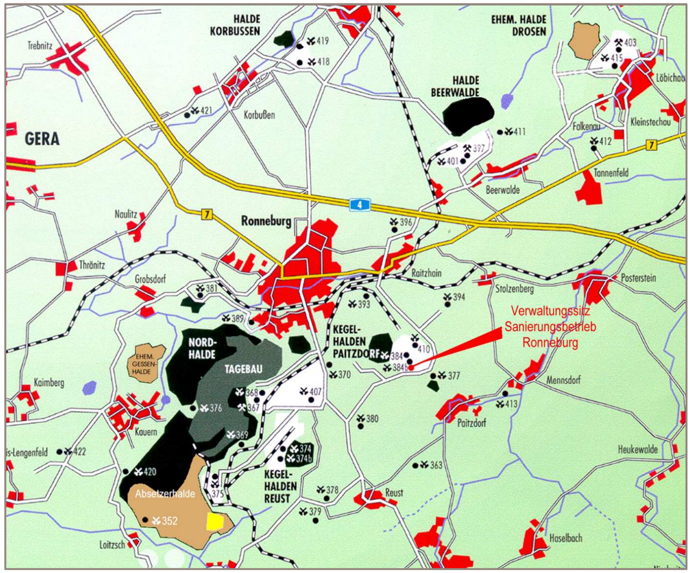
* Low grade ore





Case study: Ronneburg mine site





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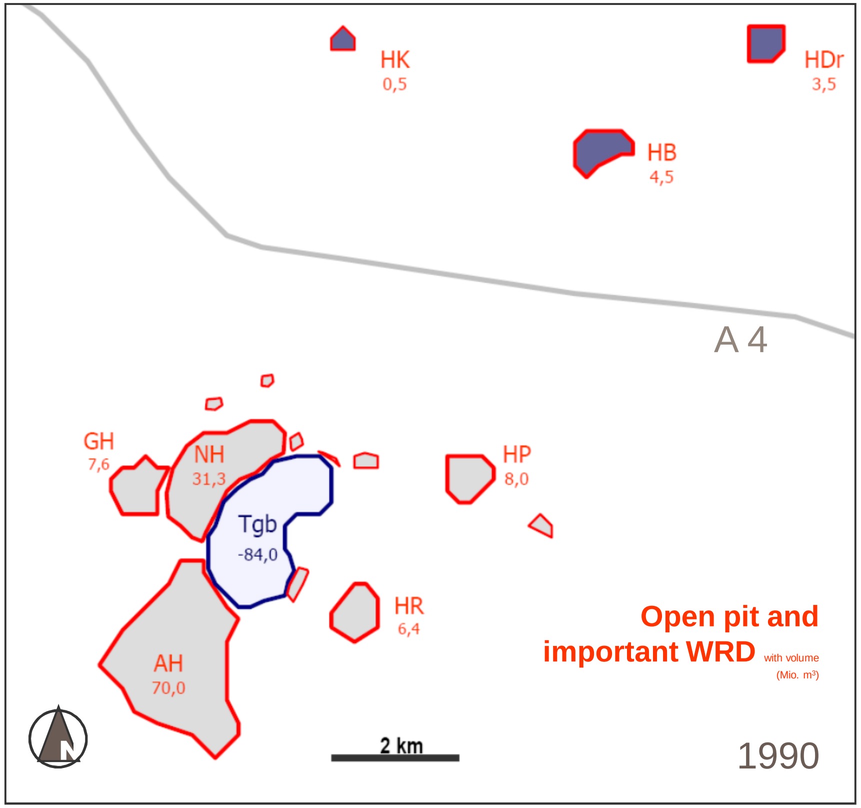
Ronneburg: Remediation strategy

- Spatial concentration of Waste rock in Lichtenberg OP key decision
- Scope: 132 Mm^3 = 230 M tonnes
- Evaluation of transport options and relocation technologies
- Necessary investment in powerful transport fleet (1993, 1995)
- Transport capacity up to 10 Mm^3/yr
- Construction of special transportation roads



Ronneburg: Investment in Mobile Technical Equipment

Technical equipment used for the waste rock relocation at Ronneburg, reflecting the situation between 1999 and 2005 (Paul & Wille 2008)

Number	Type		Aim	Tare weight (t)	Capacity (m^3)	Power (HP)
4	Dozer	CAT-D11N	Ripping/ pushing	97	34	744
2	Dozer	CAT-D11R	Ripping/ pushing	102	34	862
2	Front-end loader	CAT 994	Loading	177	18	1355
2	Front-end loader	CAT 990	Loading	75	9.2	648
11	Haul truck	CAT-785B	Transport	95	78	1399
5	Haul truck	CAT-773B	Transport	38	34	692
6	Haul truck	CAT-775D	Transport	44	42	720
2	Dozer	CAT-D9R	In-pit placement	48	16.4	411
1	Wheel Dozer	CAT-825G	In-pit placement	32	4	315
4	Grader	CAT-MG24H	Maintenance of transport routes	59	-	500
2	Grader	CAT-MG16H	Maintenance of transport routes	24.7	-	285
4	Water truck	CAT-773B	Dust control	40	50	692

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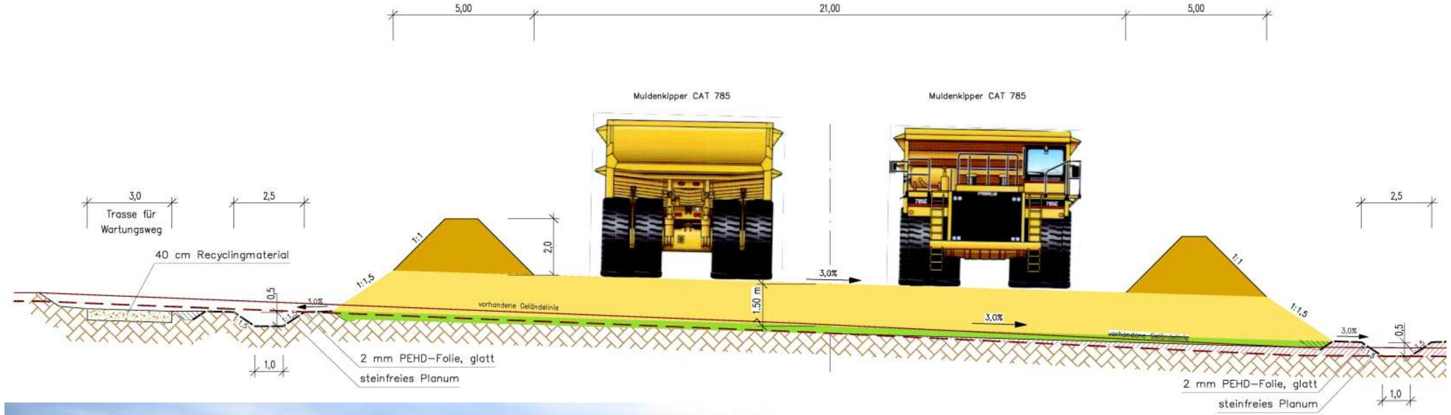
Ronneburg: Mine waste transportation

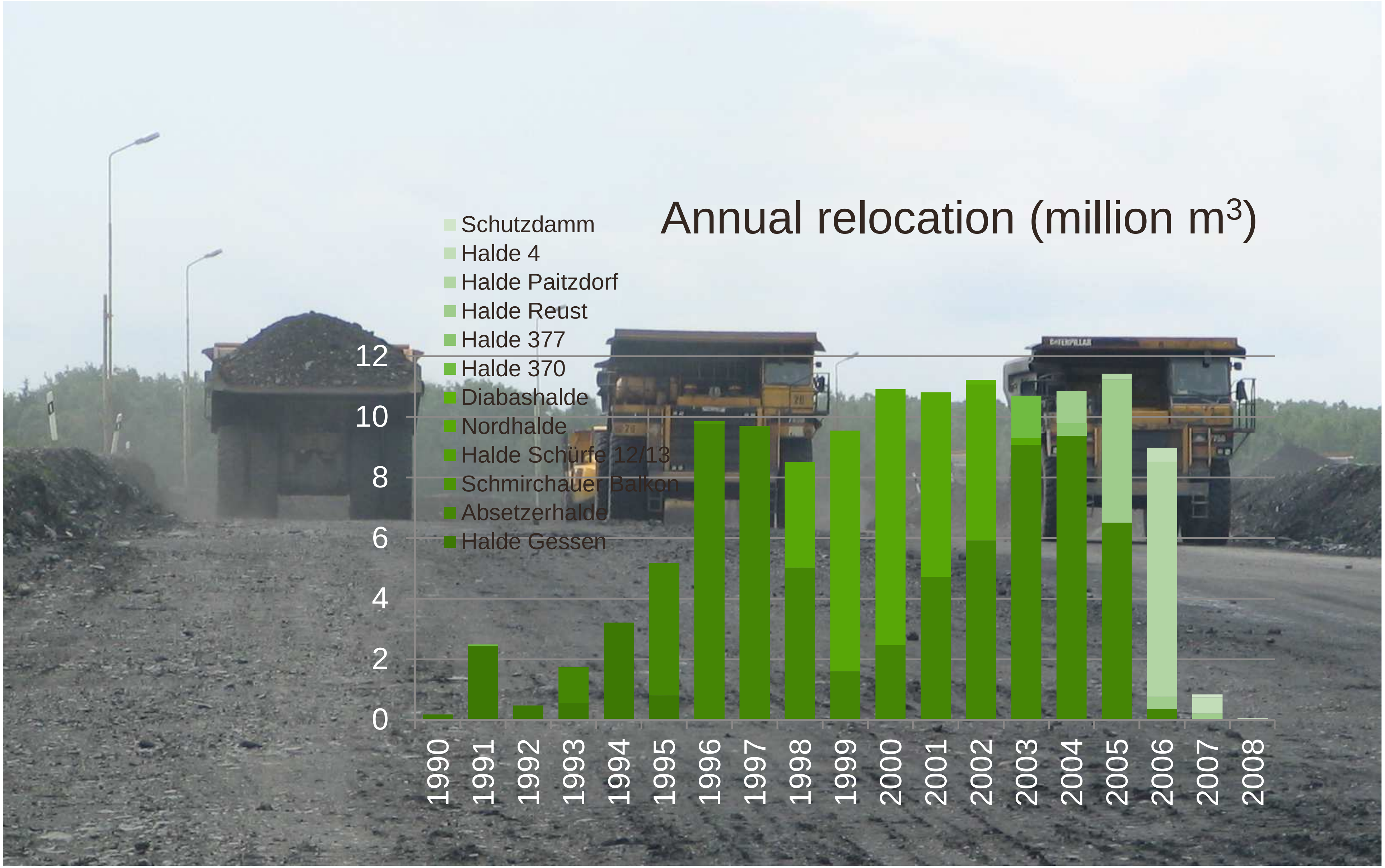


Cross section of the transportation road for the relocation of Halde Paitzdorf (source: IWU, 2004)

Construction of the transportation road from Halde Paitzdorf to the Lichtenberg open pit with waste rock. View from the dump towards the former Reust dump, which had already been relocated. June 2005

Disposal area, Ronneburg 1992

Waste rock and ash co-disposal, Ronneburg 2002



Waste Rock relocation, 2006

Shovel & truck for area clean-up

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Remediation criteria

- Secondary levels, derived from the 1 mSv/a reference level
- **Unrestricted use** of contaminated areas, buildings and mine dumps:
  - < 0,2 Bq/g for the dominating radionuclide of the U-238 decay chain
  - < 300 nSv/h ambient dose equivalent rate
- **Restricted land-use** (forestry, grassland):
  - 0,2 -1 Bq/g for the dominating nuclide
  - If >1 Bq/g site specific assessment needed
- Release for reuse of equipment and installations:
  - Total α-Surface Activity: < 0,05 Bq/cm² for unrestricted release
    < 0,5 Bq/cm² for melting of metallic scrap

Ref.: Recommendations of the German Radiation Protection Commission (SSK), 1992

Waste rock relocation, Ronneburg 2006

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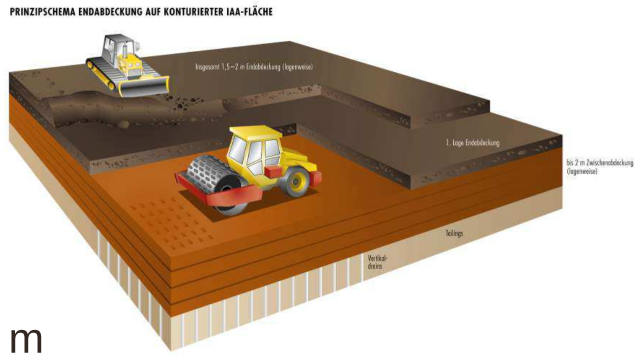
Vegetated soil covers



- Encapsulation of all artificial landforms
- Total area to be covered > 1,100 ha
- Predominant use of natural soils
- Object specific approach, cover thickness 0.5 – 2.5 m
- **Main issues:**
  - Physical stability
  - Re-utilisation
  - Limitation of radioactive exposures to the public
  - Impact on water courses (infiltration)

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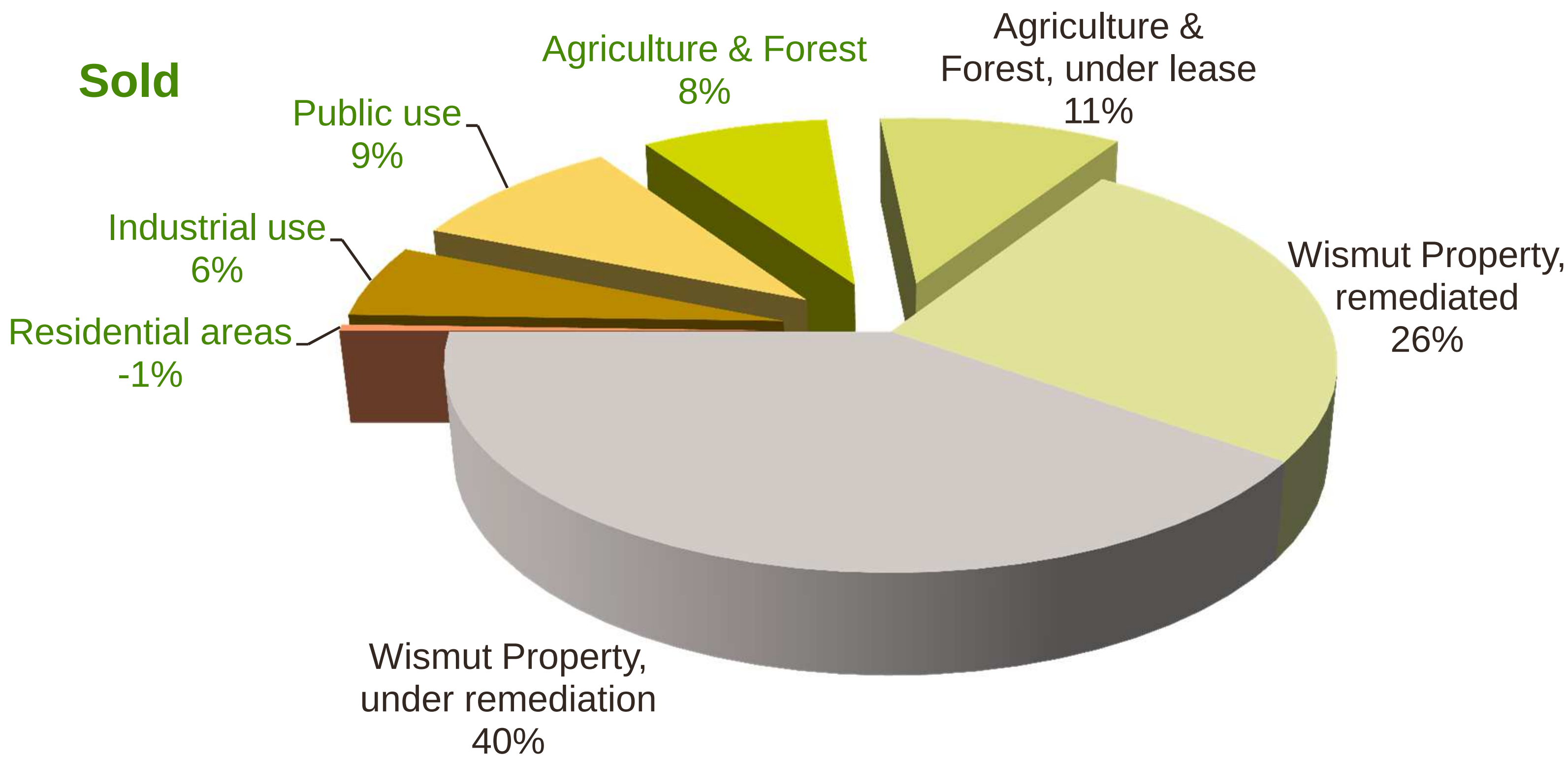
Land use and ownership structure of WISMUT's former mine land
(June 30, 2012)



Value-added after use

Enhancing Investments: Industry and Solar Parks, Ronneburg

Lessons learned: Some guiding principles

- Site related **top-down approach**, with step-by-step implementation
- **Design Planning based on EIA** and **cost benefit optimization**, within bounding remediation criteria
- Use **“Best Available Technologies”** (BAT)
- Invest in **Robust solutions** to ensure sustainability
- Strict **on-site QA/QC measures** are ultimate key to success
- Focus on **Stakeholder involvement**

Summary

- Per 12/2012: Remediation of the legacies of uranium mining in East Germany to **> 85 % successfully completed**
  - **Total expenditures: 5.7 bn EURO**
- Sustainable **limitation of radioactive and other emissions** in compliance with licences
- **Following land reclamation**, some 1,100 ha sold or leased out of a total of ca. 3,700 ha appropriated land
- Development of **state-of-the-art remedial technologies** for tailings and waste rock; water treatment; and proven in full-scale

Summary

- Core remediation tasks to be completed by ca. 2020
- **Long-term tasks** dominated by water treatment, maintenance, and environmental monitoring
- Specifics, complexity and size make WISMUT an important **international reference project** for the remediation of radioactive wastes
- Keys to success : (i) strong and decisive **political motivation**, (ii) retaining **valuable skills/infrastructure**, (iii) immediate and stable **funding**
- Remedial work pre-condition for **successfull revitalization**

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