

## Evaluation of Austria's Contaminated Sites Management and Financing System (1989 – 2006)

In 1989 a financing system for the remediation of contaminated sites was implemented by law. The system represents a comprehensive management regime, including the establishment of a public remediation funds and the identification, assessment and remediation of contaminated sites. After 17 years being in operation the Environment Ministry drew the balance. Past achievements were quantified according to the duration of management procedures, the management turnover of key organisations, the costs of investigations and remediation measures, ecologic aspects, and economic aspects. Based on the quantification of past achievements a forecast for the next decades was made. Finally recommendations how to improve the system were drawn in order to meet the national remediation target that requires the identification of all contaminated sites until 2025 and the completion of clean-up measures at the most heavily contaminated sites until 2050.

**Investigation & Assessment.** 373 sites were subject to a site specific risk assessment. The size of the assessed sites together adds up to 23 km<sup>2</sup> corresponding to the size of a small city. 234 sites were qualified as “in need of remediation”. More than half of the conducted investigations were financed by the public at total costs of 25 million Euro. On average a site investigation amounted to 51.000 Euro. Today 25 to 30 site specific risk assessments are carried out per year by the responsible authorities. In the early years assessed sites were usually qualified as “in need of remediation” whereas today only one quarter of the assessed sites receives this qualification. The reason for this change lies in the better knowledge of source-receptor pathways and contaminant mobility.

**Remediation measures.** 144 of 234 contaminated sites were subject to clean-up measures and funded or financed with public means. Total costs of these measures amounted to 1.1 billion Euro of which 80% were derived from public funds. Another 25 sites were remediated without public funding at unknown costs.

Implemented remediation technologies were conventional dump and dig technologies with a share of 44%, in-situ technologies with 24%, and containment technologies with 22% respectively. In-situ technologies were implemented at 35 sites and consumed only 2% of the total remediation budget. For all technologies average costs were derived:

Treatment	Average Costs	Units
Soil excavation	6.6	€/t
Transport and disposal of contaminated soil	13 - 186	€/t
On-site treatment of contaminated soil	21.3	€/t
Containment wall	101	€/m <sup>2</sup>
Groundwater containment	1.6	€/m <sup>3</sup>
Surface sealing	28	€/m <sup>2</sup>
In-situ treatment of groundwater	0.25	€/m <sup>3</sup>
In-situ treatment of soil gas	0.05	€/m <sup>3</sup>

**Duration of management steps.** The life cycle of a contaminated site from the identification to the completion of remediation measures was on average 13 years. It takes around 4 years until detailed assessments are completed, another year until a site is qualified as “in need of remediation” and another 7 years for the completion of remediation measures.

**Ecologic Effects.** Implemented remediation measures improved the water quality of groundwater bodies with a volume of 46 million m<sup>3</sup>. This corresponds to an annual water consumption of 1.7 million persons. Contaminants of 9.9 million m<sup>3</sup> soil were prevented from further spreading into sensitive environments. 145 hectare brownfield land was reused and in eight cases evaporation of landfill gas was averted.

Austrian remediation measures generate about 1% of the annual waste production and 10% of Austria's disposed waste. In 1990 landfill gases contributed to the national green house gas balance with 4.3% where as in 2006 the contribution was only 0.8%.

Annual water abstraction of remediation measures amounts today to 14 million m<sup>3</sup> water, corresponding to an annual water consumption of 256,000 persons whereas annual energy consumption amounts to 17 gig watt hours corresponding to the annual energy consumption of 2,150 persons (including fuel consumption along soil transport).

**Economic Effects.** Austrian contaminated sites management creates about 330 full time jobs per year. A considerable amount of remediation costs is consumed by disposal costs, a cost factor which is not very labour intensive.

**Forecast.** The survey predicts another 1,950 sites in need of remediation, of which 85% are expected to be small and medium sized sites with volatile organic and hydrocarbon contamination. Total remediation costs are estimated with 5 to 6 billion €.

Austria's management system for contaminated sites has changed considerably since 1989. A lot of improvements took place and the assessment of sites is today far more efficient than 17 years ago. However, the national remediation target requires the identification of all contaminated sites until 2025 and the completion of clean-up measures at the most heavily contaminated sites until 2050. The survey has shown that the current system is too slow to meet the national target and that changes for all parties involved will be necessary, this includes a revision of the current legislation, the establishment of site and use specific remediation targets, development and demonstration of cost effective remediation technologies, and an increase of management capacity for the responsible authorities.

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