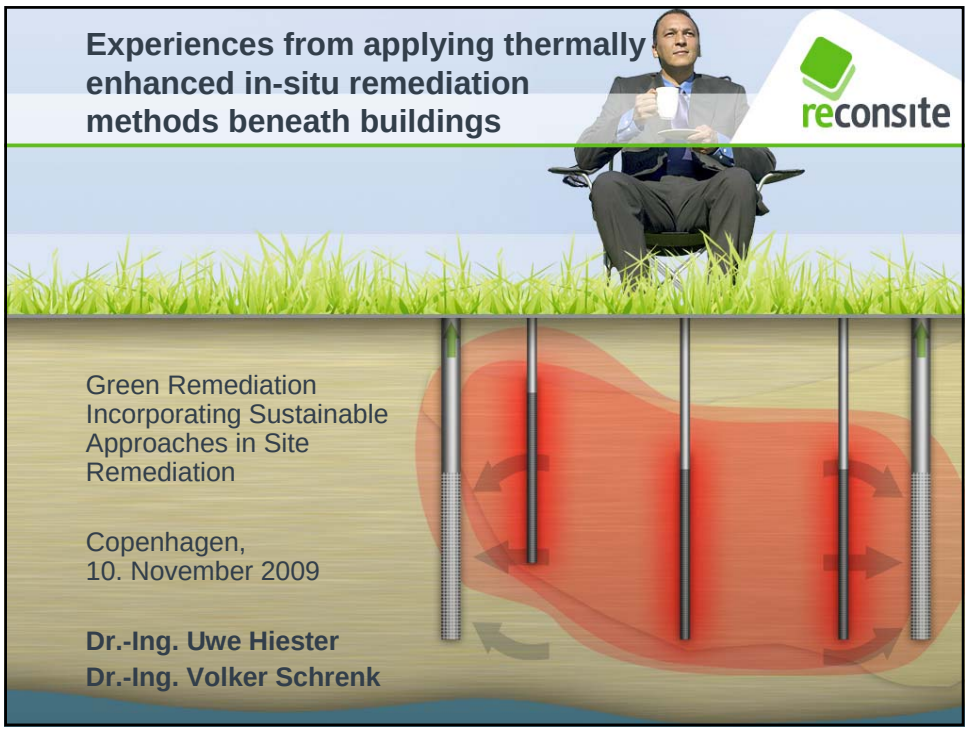
# Experiences from applying thermally enhanced in-situ remediation methods beneath buildings

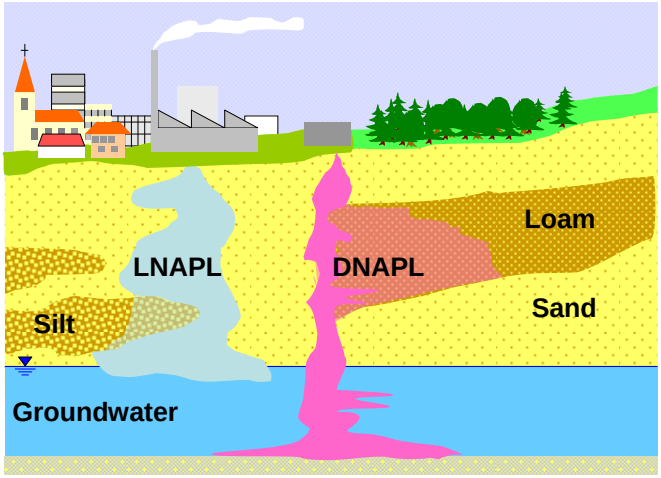


Green Remediation Incorporating Sustainable Approaches in Site Remediation

Copenhagen,
10. November 2009

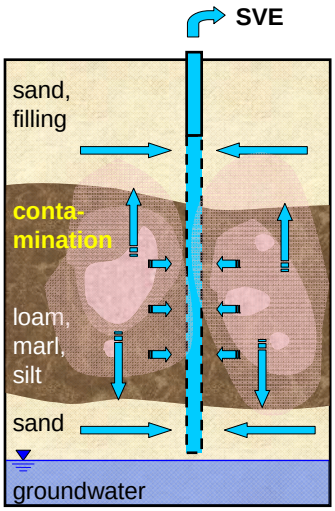
**Dr.-Ing. Uwe Hiester**
**Dr.-Ing. Volker Schrenk**

## Application of thermally enhanced in-situ remediation

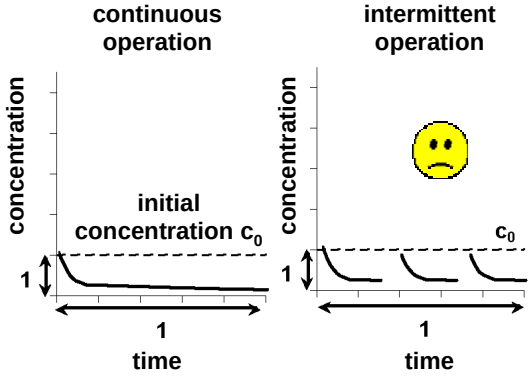



- in-situ-source removal
- organic contaminants
- LNAPL & DNAPL
- non cohesive & cohesive soil

## Conventional ‘cold‘ SVE



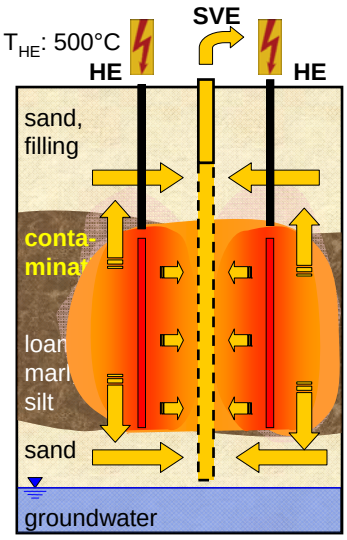

**conventional soil vapor extraction (SVE): usually several years of operation**




Altenbockum et al. 1997



## Thermally enhanced SVE



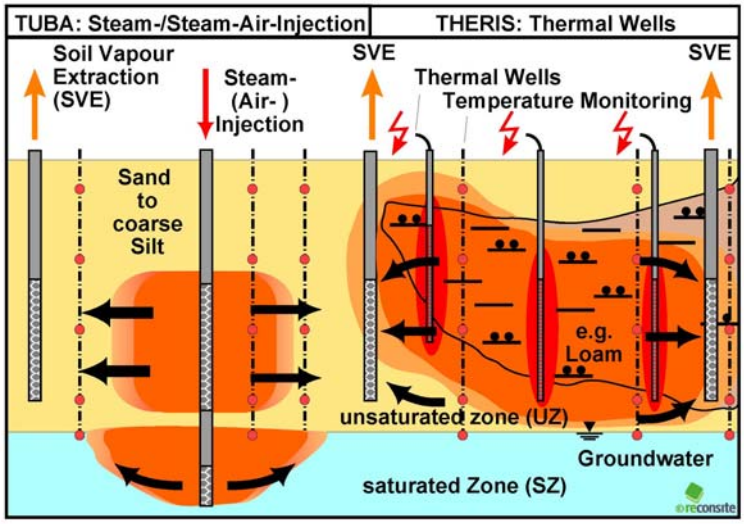

- **soil vapor extraction (SVE)**
- **air treatment system**

**Target:**

- liquid contaminant (10 °C)
  ⇒ gaseous phase
- short remediation time

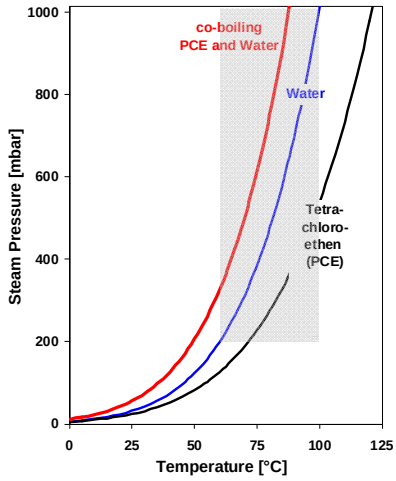
**THERIS** = **Ther**mally enhanced **i**n-**s**itu remediation with thermal wells

## Thermally enhanced in-situ remediation

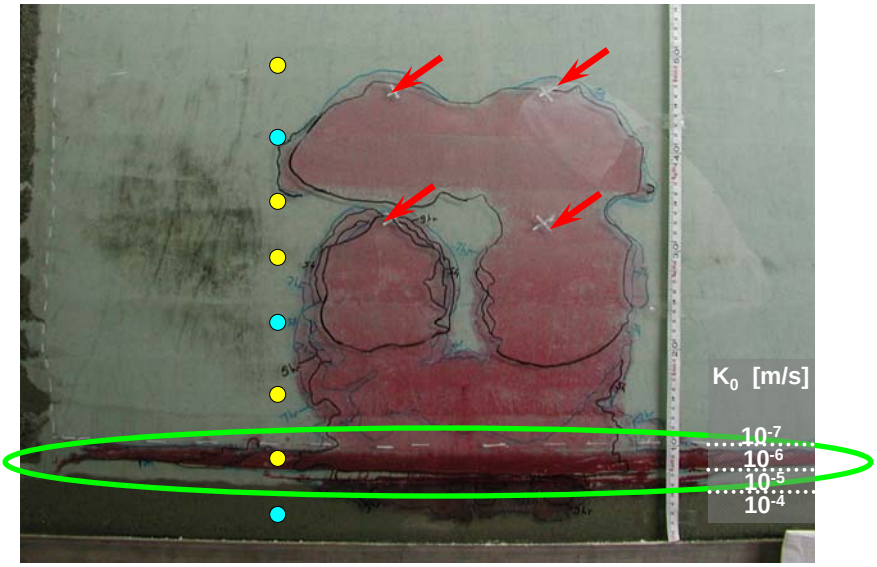




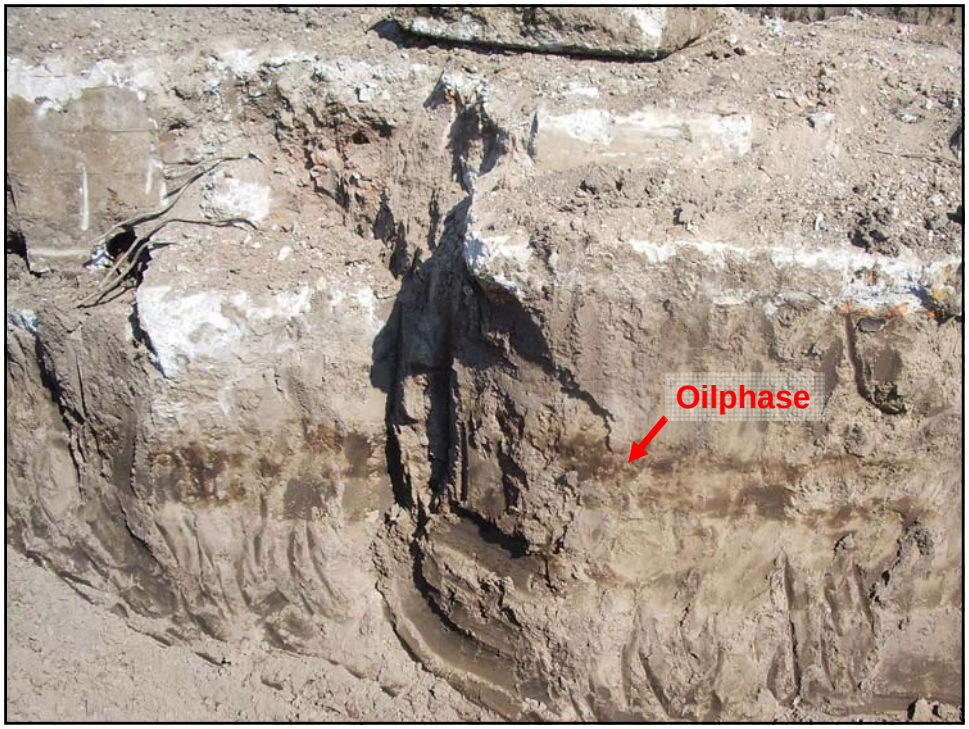

## Boiling of water and contaminant phase



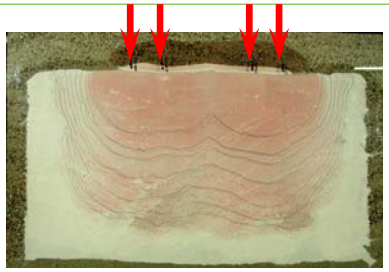
## Contaminant Distribution



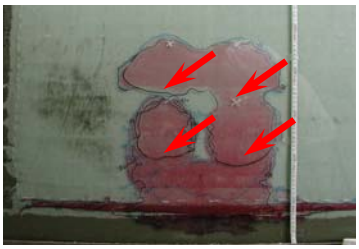


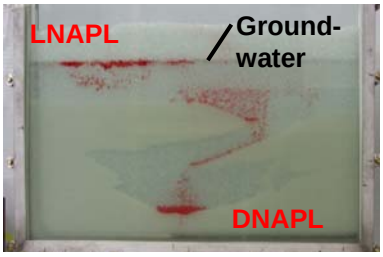
## Contaminant Distribution



from Hiester 2003



from Hiester 2006




from Greiner 2006

from Färber 2007



## Installation

**foundation**

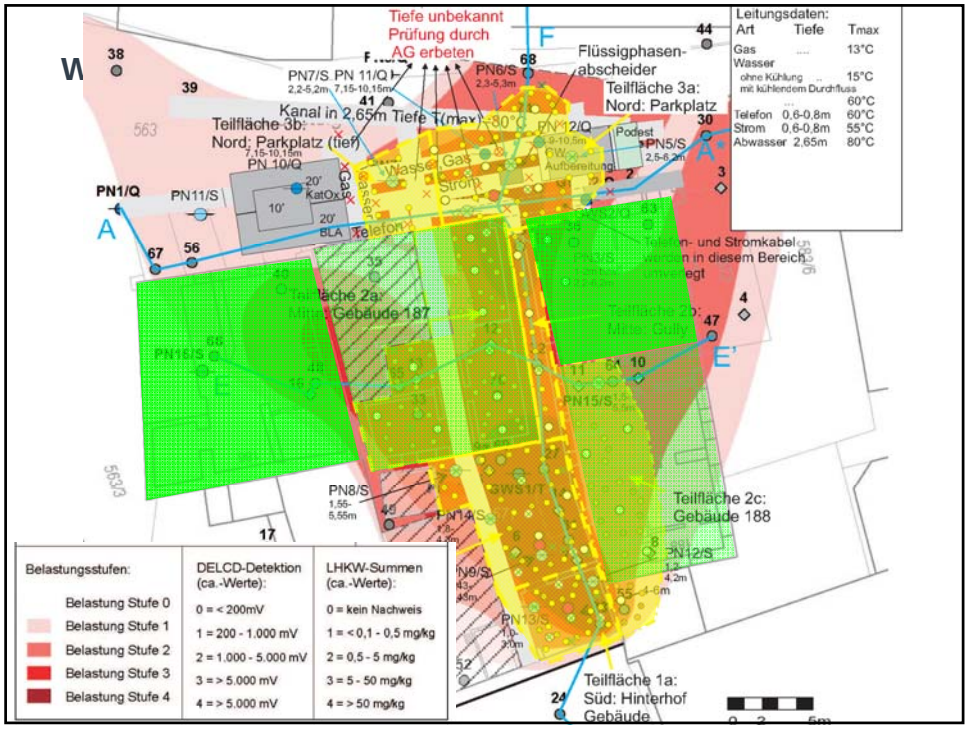
**pipelines (below building)**

**Sealing of bore holes**

## Covering of Installation



## Workshop usage during THERIS remediation


Tiefe unbekannt
Prüfung durch
AG erbeten
Flüssigphasen-
abscheider
Teilfläche 3a:
Nord: Parkplatz
Kanal in 2,65m Tiefe T(max) 80°C
Teilfläche 3b:
Nord: Parkplatz (tief)
PN7/S PN 11/Q
PN6/S
PN12/Q
PN5/S
PN10/Q
PN1/Q
PN11/S
Podest
Wasser Gas
Strom
Telefon
Telefon- und Stromkabel
werden in diesem Bereich
verlegt
Teilfläche 2a:
Mitte: Gebäude 187
Teilfläche 2b:
Mitte: Gully
PN15/S
PN18/S
PN8/S
PN14/S
Teilfläche 2c:
Gebäude 188
PN12/S
PN13/S
Teilfläche 1a:
Süd: Hinterhof
Gebäude
Leitungsdaten:
Art Tiefe Tmax
Gas .... 13°C
Wasser
ohne Kühlung .. 15°C
mit kühlendem Durchfluss
... 60°C
Telefon 0,6-0,8m 60°C
Strom 0,6-0,8m 55°C
Abwasser 2,65m 80°C
Belastungsstufen:
Belastung Stufe 0
Belastung Stufe 1
Belastung Stufe 2
Belastung Stufe 3
Belastung Stufe 4
DELCD-Detektion (ca.-Werte):
0 = < 200mV
1 = 200 - 1.000 mV
2 = 1.000 - 5.000 mV
3 = > 5.000 mV
4 = > 5.000 mV
LHKW-Summen (ca.-Werte):
0 = kein Nachweis
1 = < 0,1 - 0,5 mg/kg
2 = 0,5 - 5 mg/kg
3 = 5 - 50 mg/kg
4 = > 50 mg/kg


03/06/2009

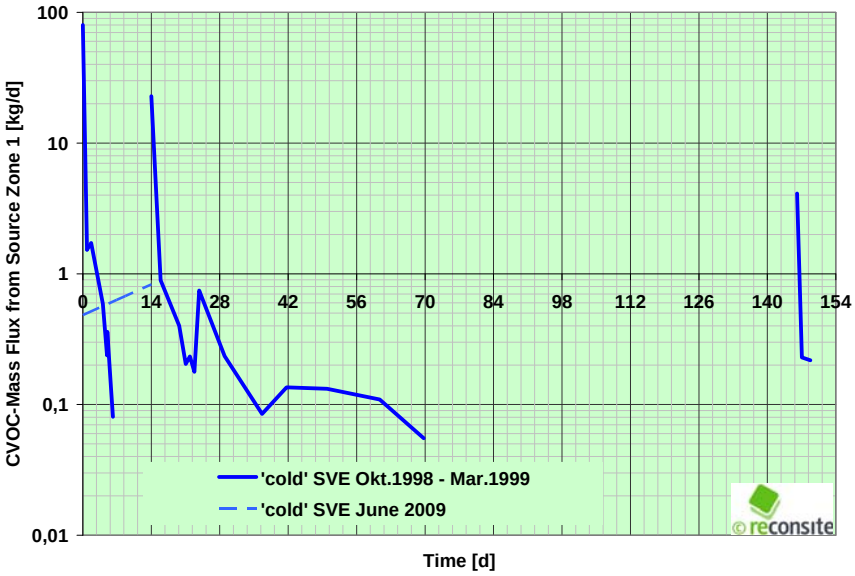

## Online Measurement Systems

reconsite

## Online Measurement Systems




## Comparison ‘cold‘ SVE with THERIS



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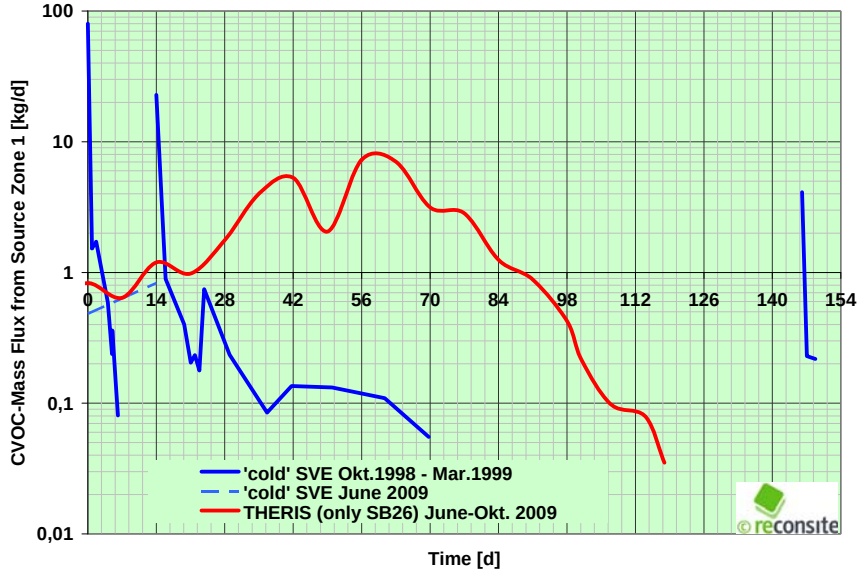
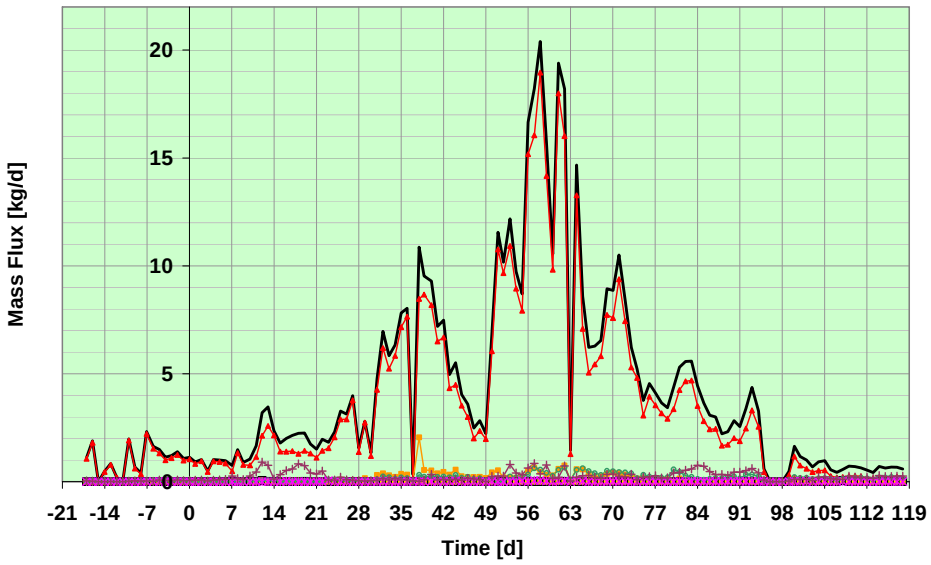
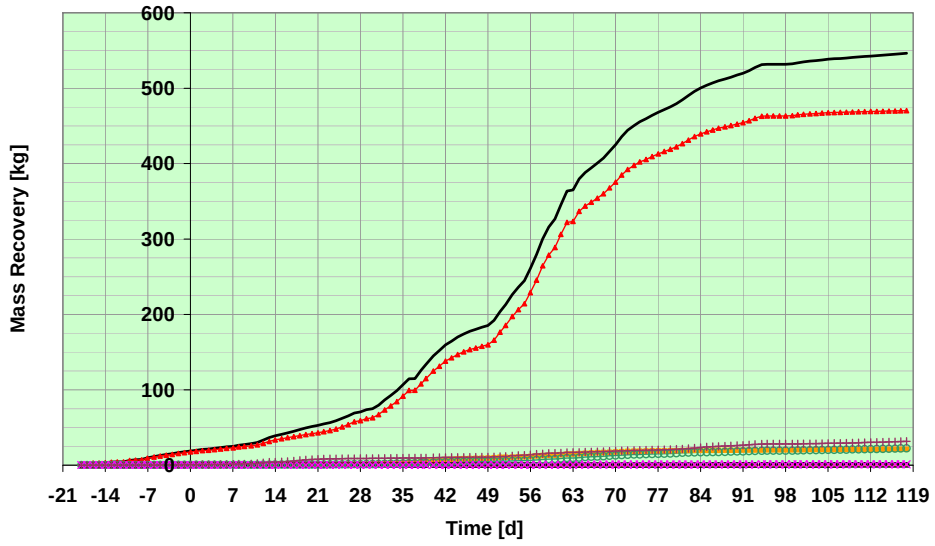





## Mass flux during THERIS remediation

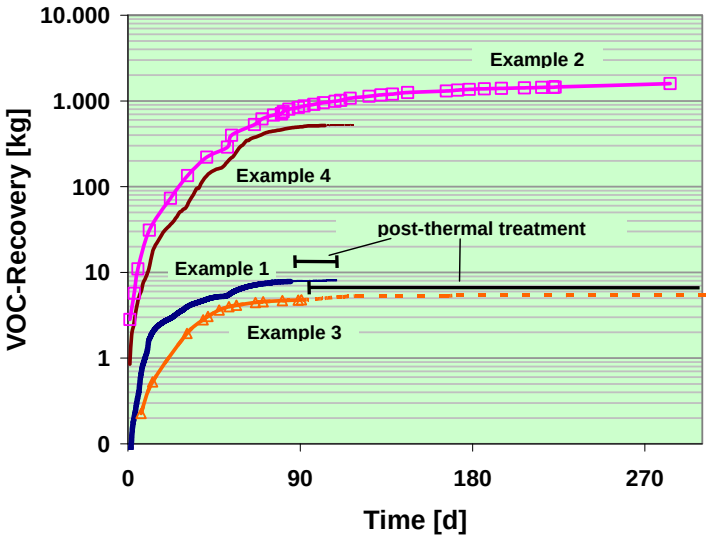


## Mass recovery by THERIS remediation

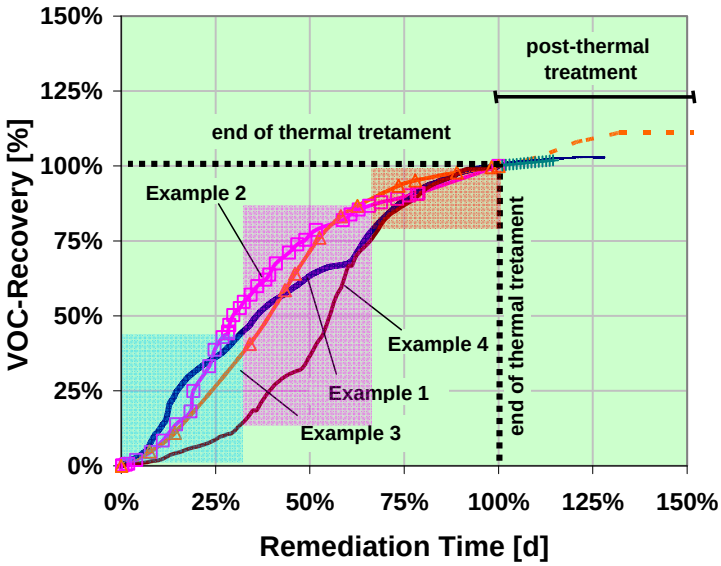





## Mass Recovery

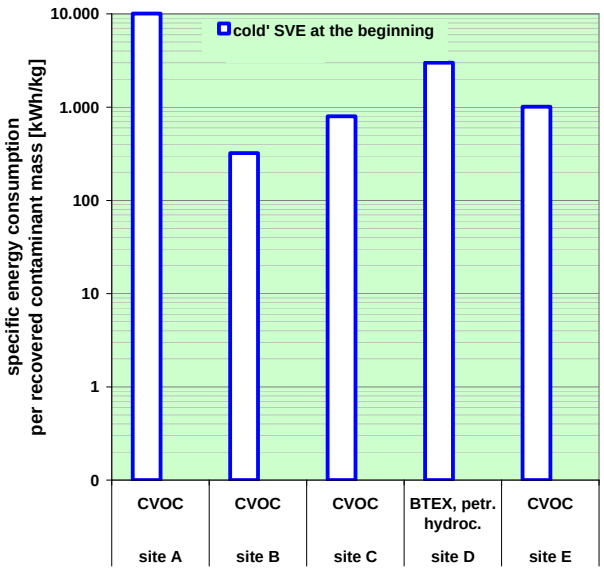


## Mass Recovery






## Workshop usage during THERIS remediation



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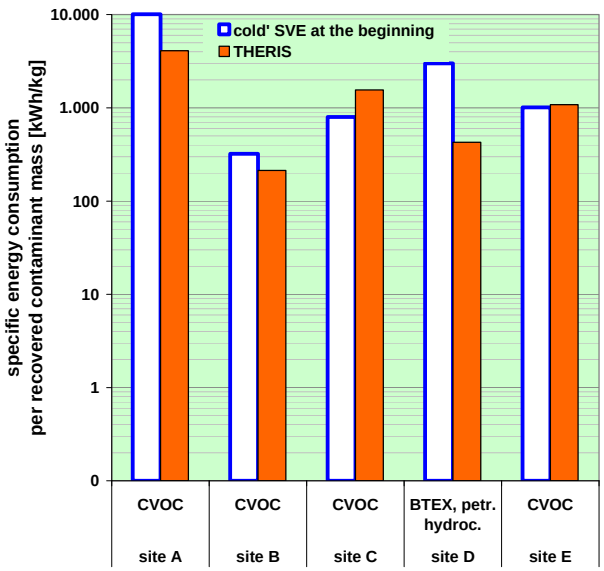
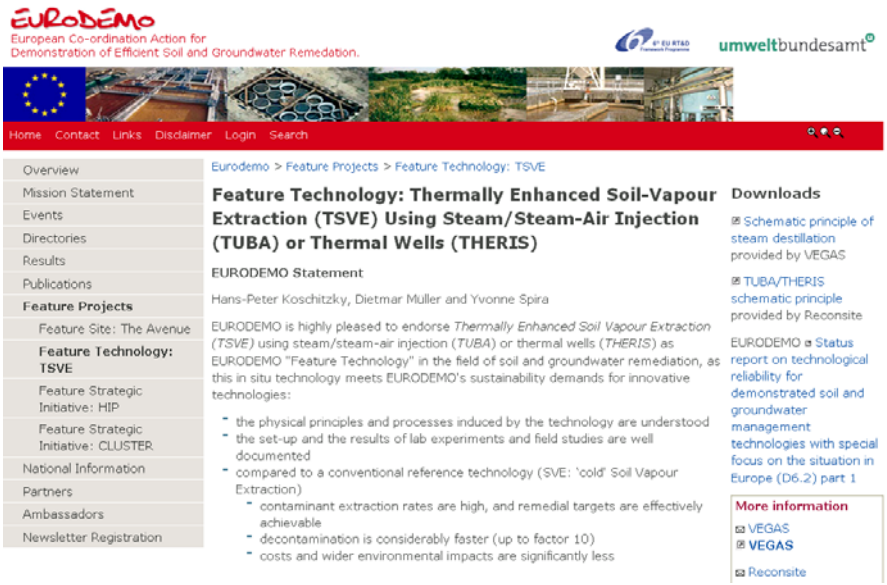





## Evaluation of the technology



EURODEMO
European Co-ordination Action for Demonstration of Efficient Soil and Groundwater Remediation.

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Eurodemo > Feature Projects > Feature Technology: TSVE

**Feature Technology: Thermally Enhanced Soil-Vapour Extraction (TSVE) Using Steam/Steam-Air Injection (TUBA) or Thermal Wells (THERIS)**

**EURODEMO Statement**

Hans-Peter Koschitzky, Dietmar Müller and Yvonne Spira

EURODEMO is highly pleased to endorse *Thermally Enhanced Soil Vapour Extraction (TSVE)* using steam/steam-air injection (*TUBA*) or thermal wells (*THERIS*) as EURODEMO "Feature Technology" in the field of soil and groundwater remediation, as this in situ technology meets EURODEMO's sustainability demands for innovative technologies:

- the physical principles and processes induced by the technology are understood
- the set-up and the results of lab experiments and field studies are well documented
- compared to a conventional reference technology (SVE: 'cold' Soil Vapour Extraction)
  - contaminant extraction rates are high, and remedial targets are effectively achievable
  - decontamination is considerably faster (up to factor 10)
  - costs and wider environmental impacts are significantly less

**Downloads**

- Schematic principle of steam destillation provided by VEGAS
- TUBA/THERIS schematic principle provided by Reconsite

EURODEMO Status report on technological reliability for demonstrated soil and groundwater management technologies with special focus on the situation in Europe (D6.2) part 1

**More information**

- VEGAS
- VEGAS
- Reconsite

## Conclusions

- Thermally enhancements can be efficiently applied for the in-situ remediation of the unsaturated and the saturated zone.
- Thermally enhancements can enable a continued usage of the building during remediation.
- Thermally enhancements consume less energy than ‘cold‘ SVE.
- The quality of site evaluation effects the quality of the design.
- The remediation goals can effect the efficiency.

# Heat-up and relax

**Thermally enhanced In-situ-Remediation**

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