
TOGETHER WE
MAKE TOMORROW
MORE BEAUTIFUL

Overview of current remediation projects in Flanders, and trends for the future

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Content

- Introduction
- Facts and figures
- 3 cases
- Conclusions

Who are we and what do we stand for?
Our mission

- Who are we?
  The Public Waste Agency of Flanders

- What do we stand for?

OVAM wants to contribute to a better environment and quality of life. We do this by:

- ensuring a sustainable management of **waste** and **materials**;
- preventing **soil pollution** and carrying out **soil remediation**.

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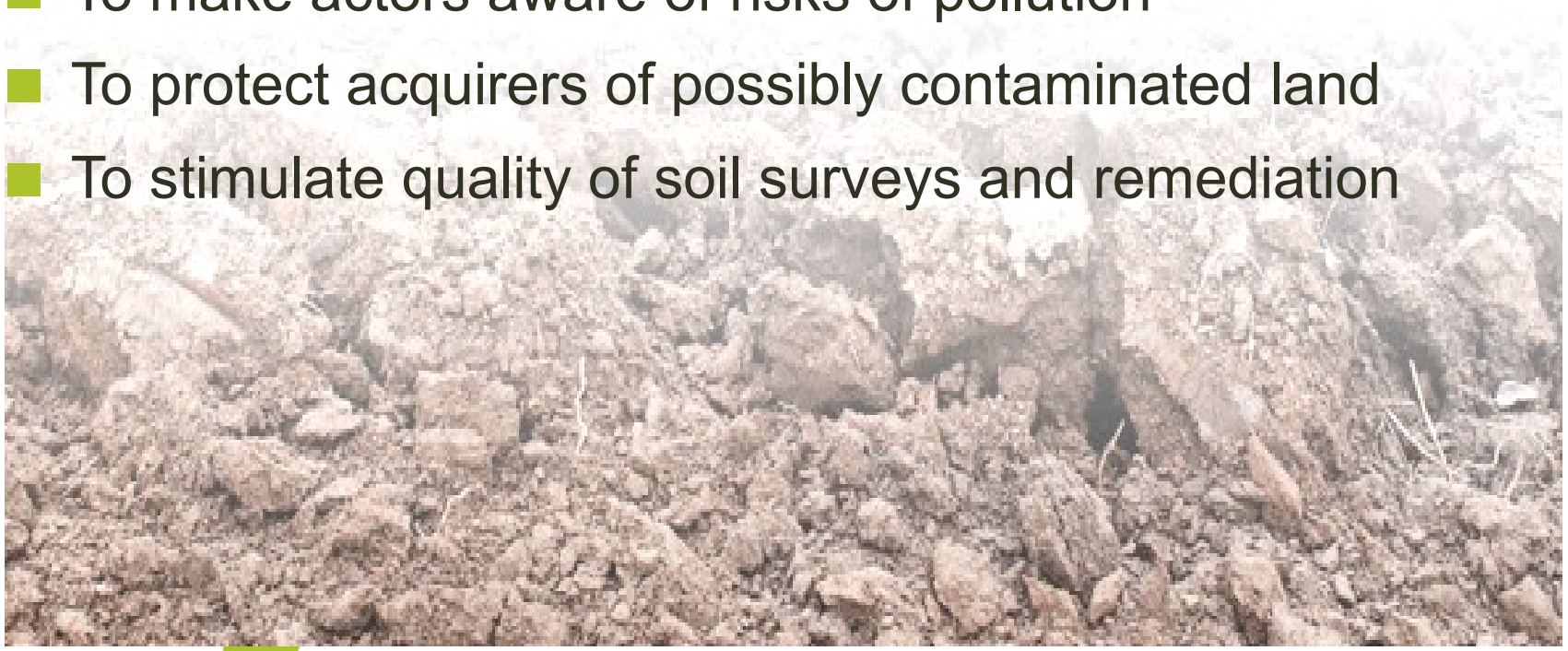
What do we stand for?
Main objectives of our soil policy

- To stimulate market parties to carry out soil surveys and remediation
- To stimulate prevention of soil pollution
- To make actors aware of risks of pollution
- To protect acquirers of possibly contaminated land
- To stimulate quality of soil surveys and remediation



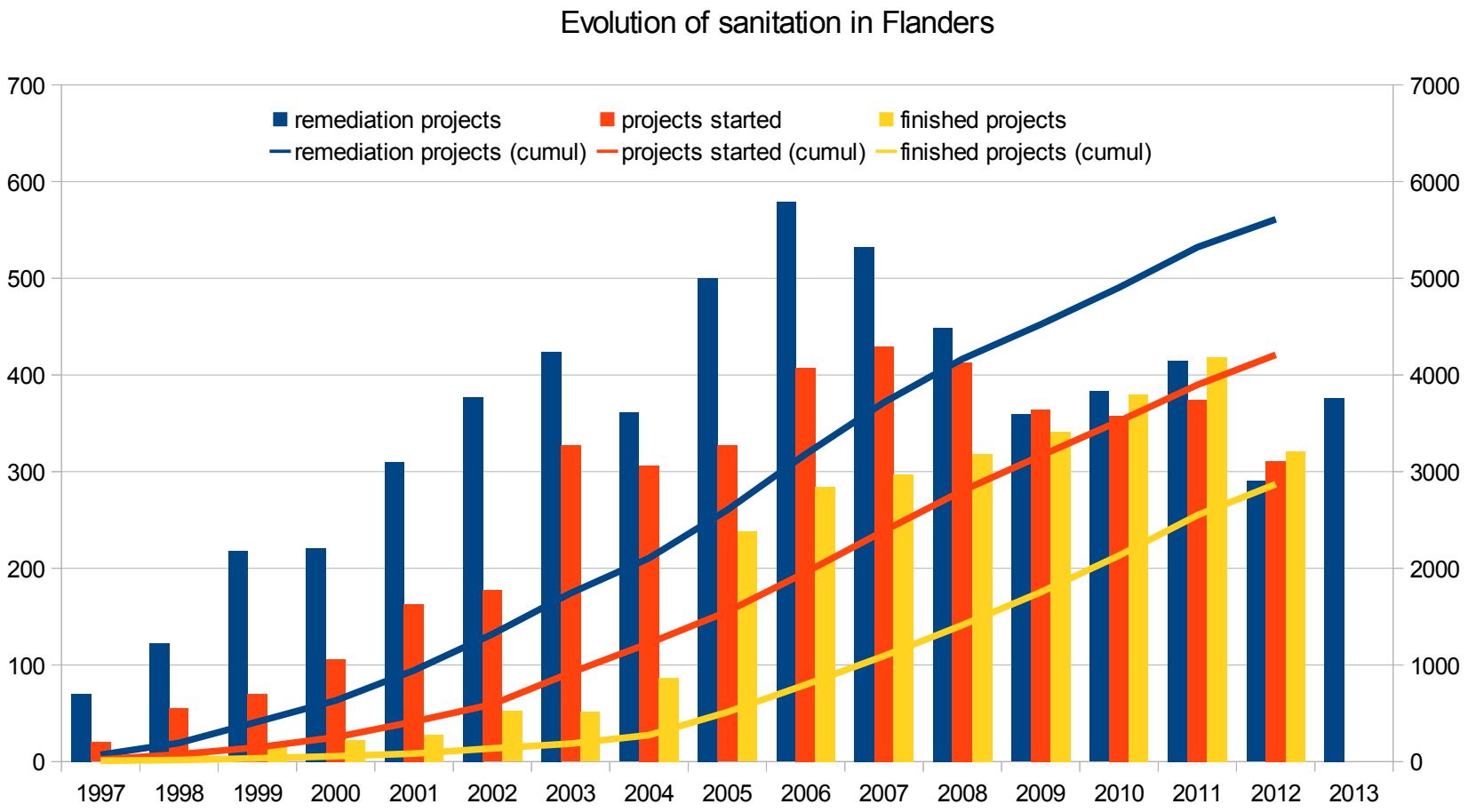
What do we do?

The OVAM is responsible for the approval and follow up of the remediation projects in Flanders.

In 1995 - 1996, the soil decree was implemented and people started with the research of their properties, the first remediations according to the soil decree are dated 1997.

During the years we received about 5700 remediation projects.

An overview

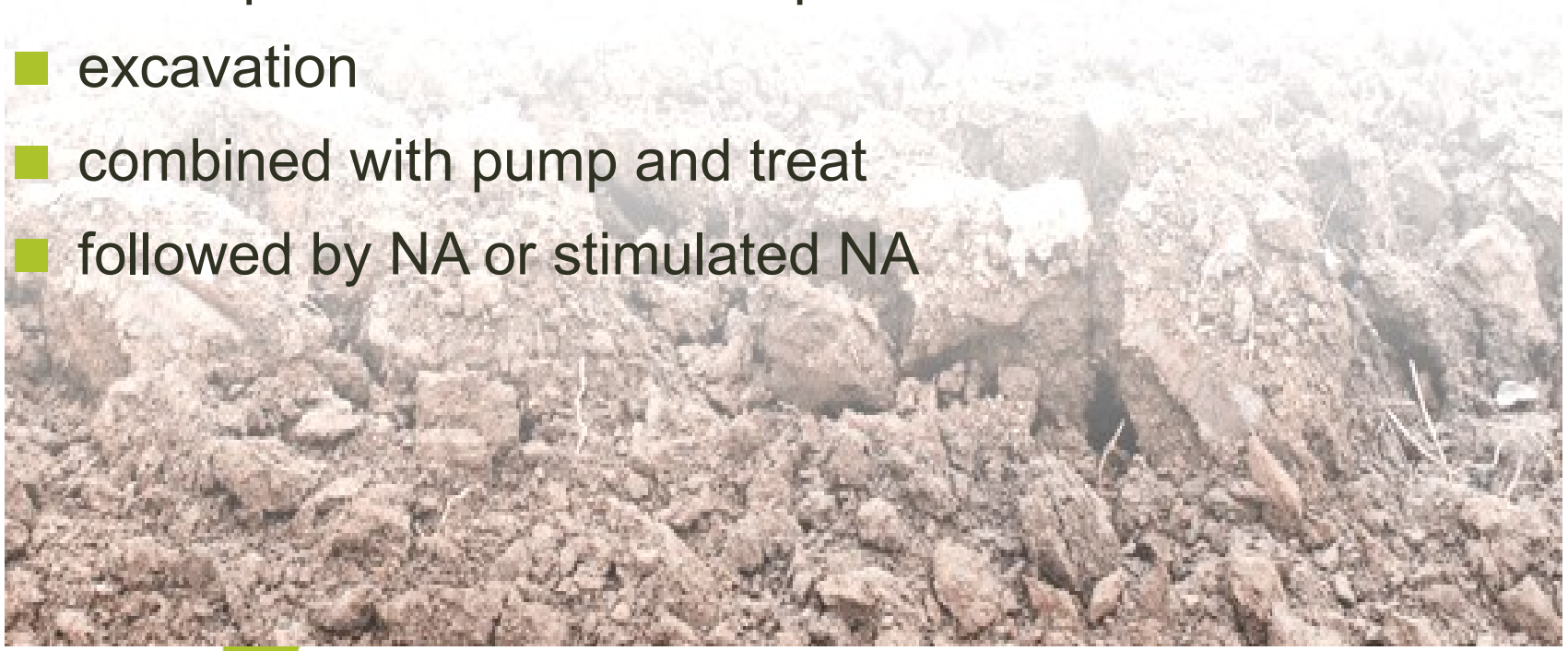


Remediation techniques

A remediation project is mostly build up based on different remediation techniques.

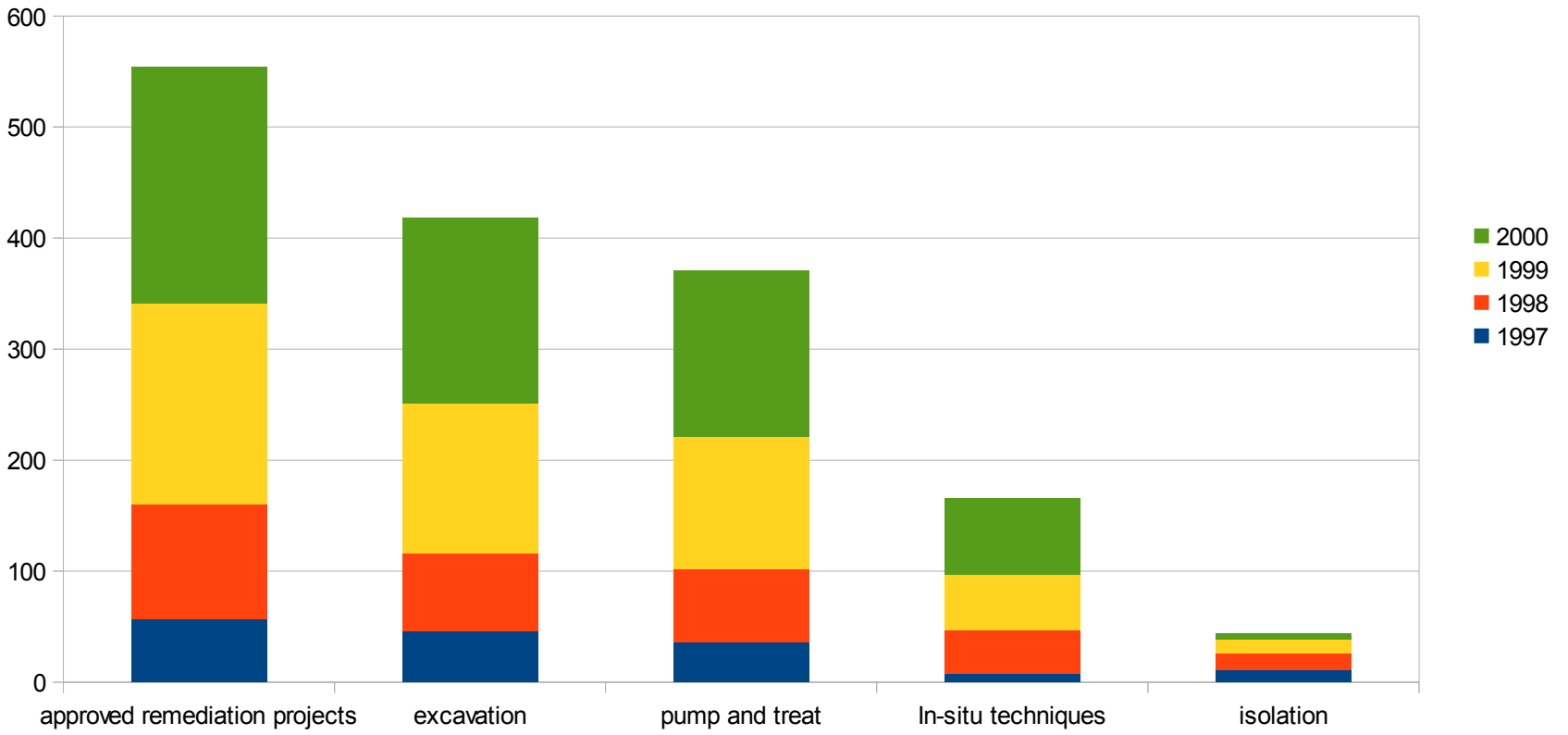
For example: remediation of a petrol station:

- excavation
- combined with pump and treat
- followed by NA or stimulated NA

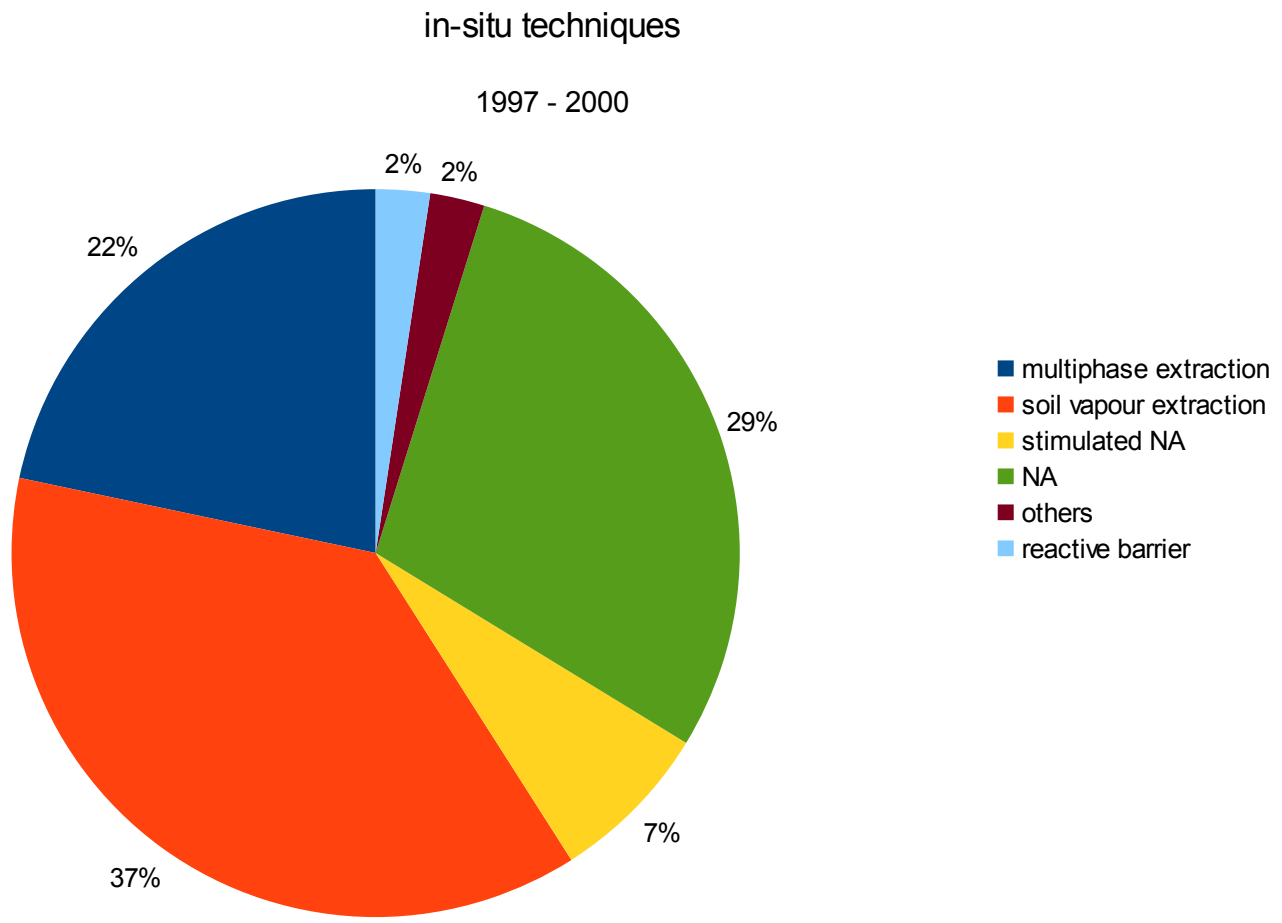


Remediation techniques 1997 - 2000

In the first 4 years OVAM approved about 550 remediation projects



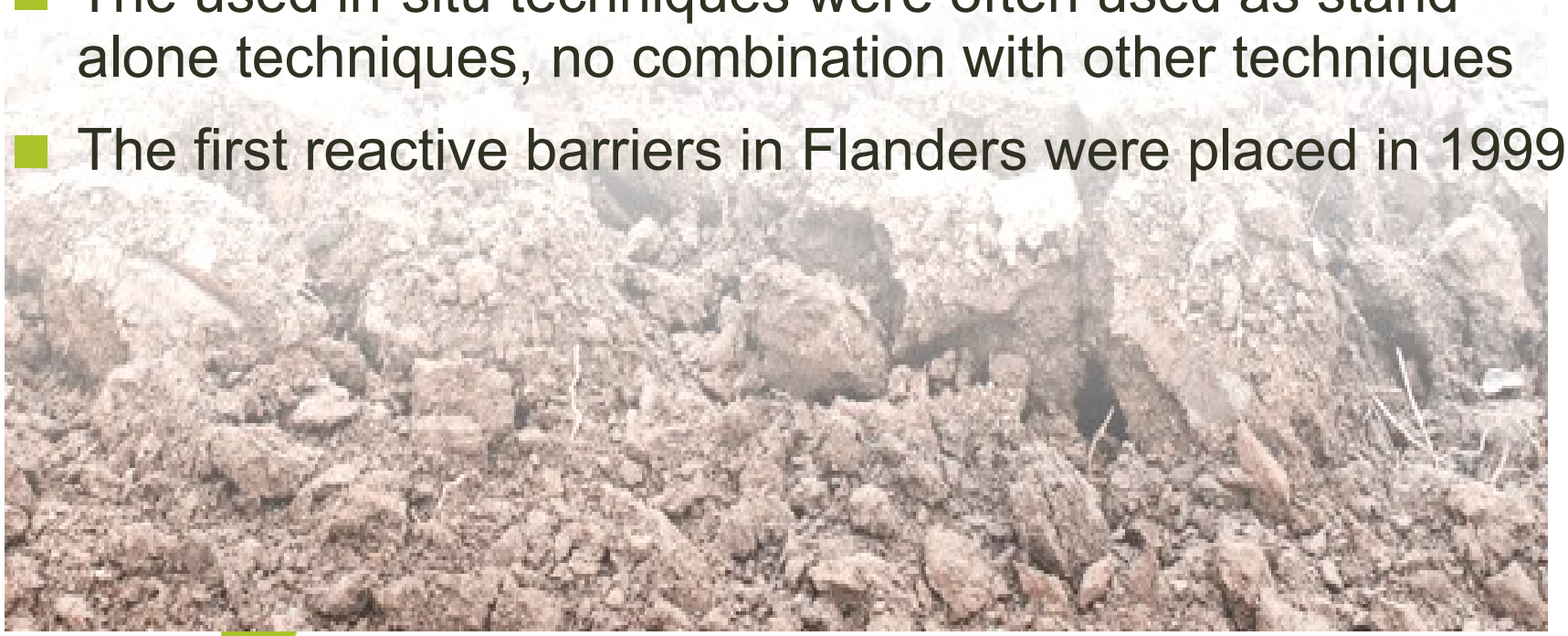
In situ remediation techniques 1997 - 2000



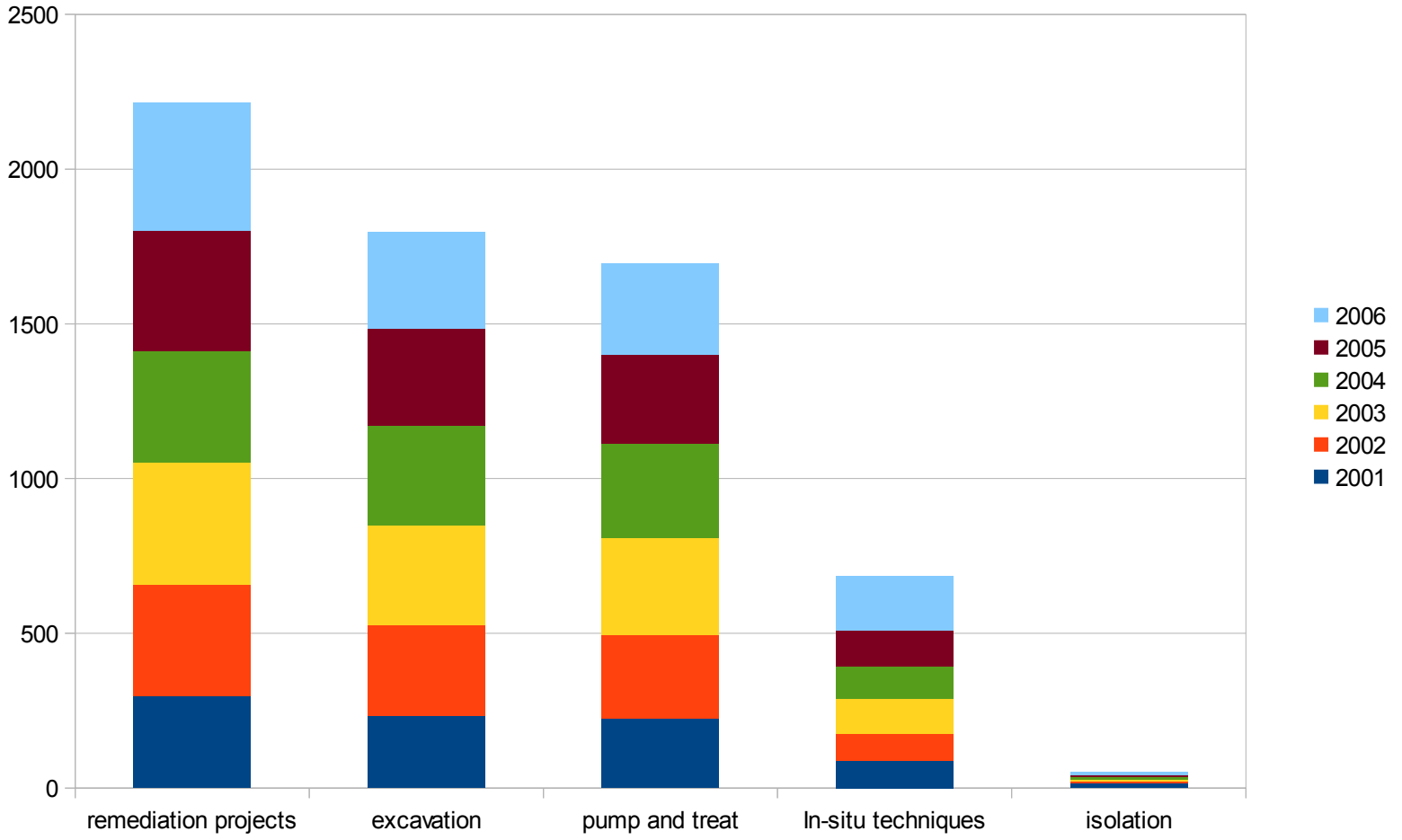
Remediation techniques 1997 - 2000

Conclusions:

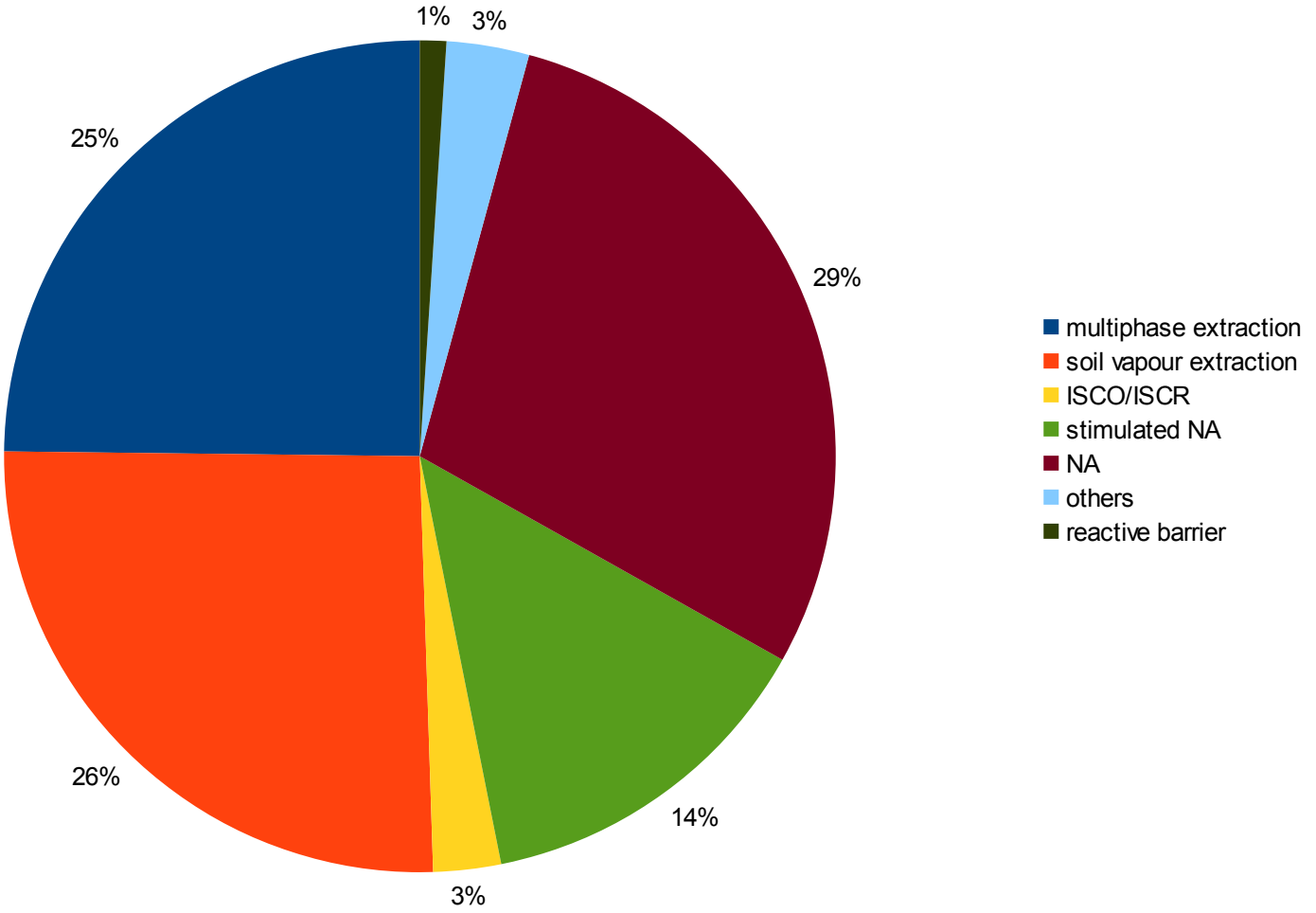
- Limited use of more complex in-situ techniques
- More NA than stimulated NA
- The used in-situ techniques were often used as stand alone techniques, no combination with other techniques
- The first reactive barriers in Flanders were placed in 1999



Remediation techniques 2001 - 2006



In-situ remediation techniques 2001 - 2006

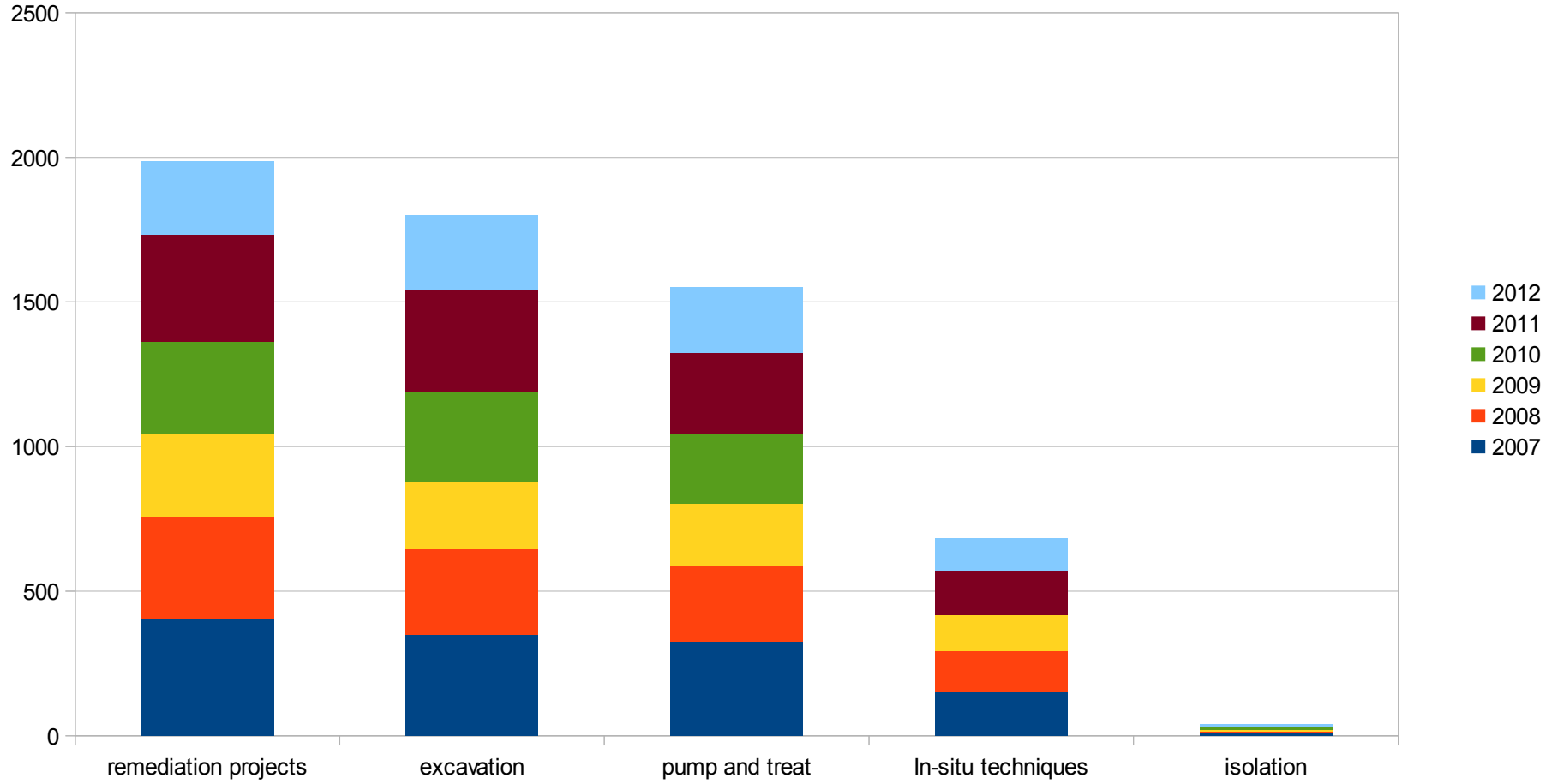


Remediation techniques 2001 - 2006

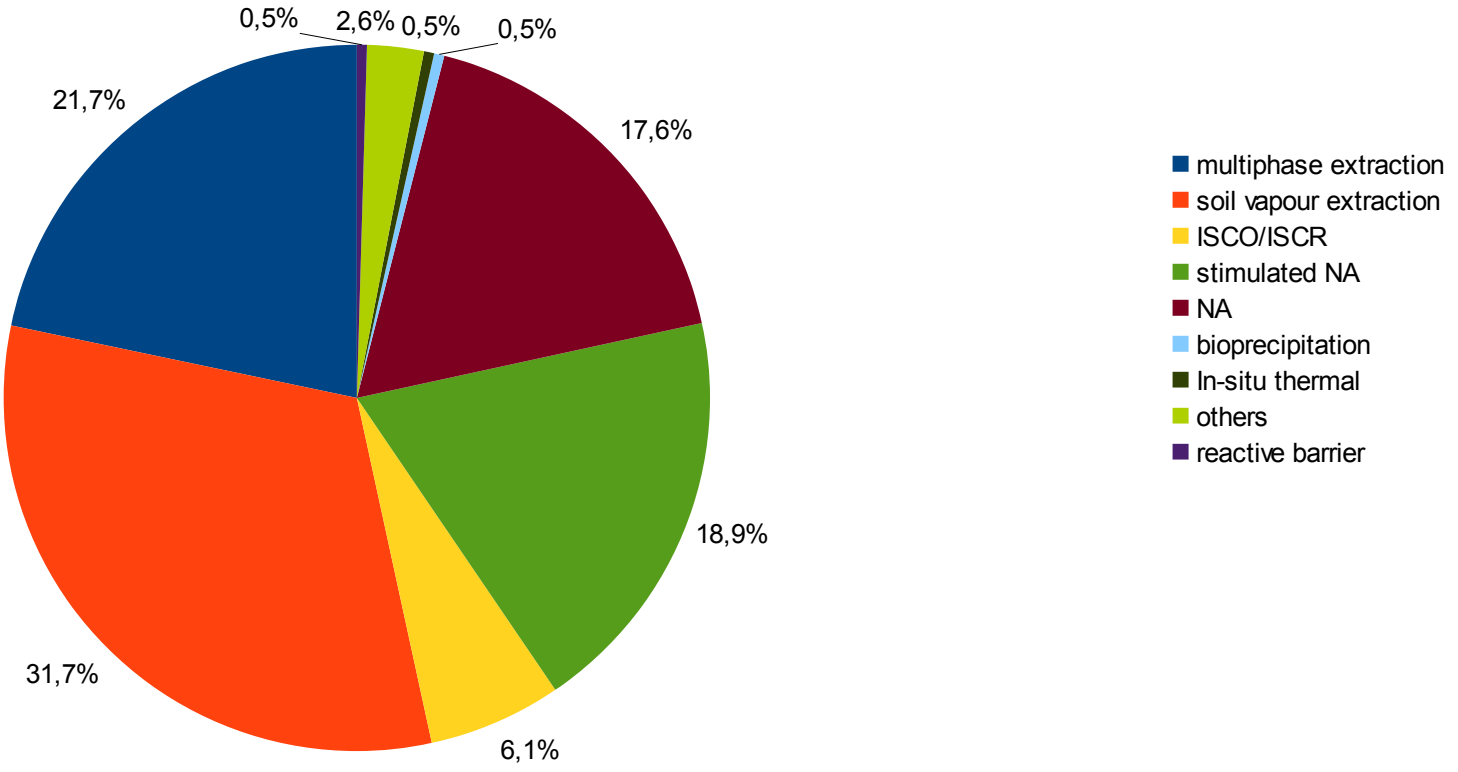
Conclusions:

- More use of complex in-situ techniques
- ISCO is used for the first time in 2001
- Isolation as a remediation concept is rare

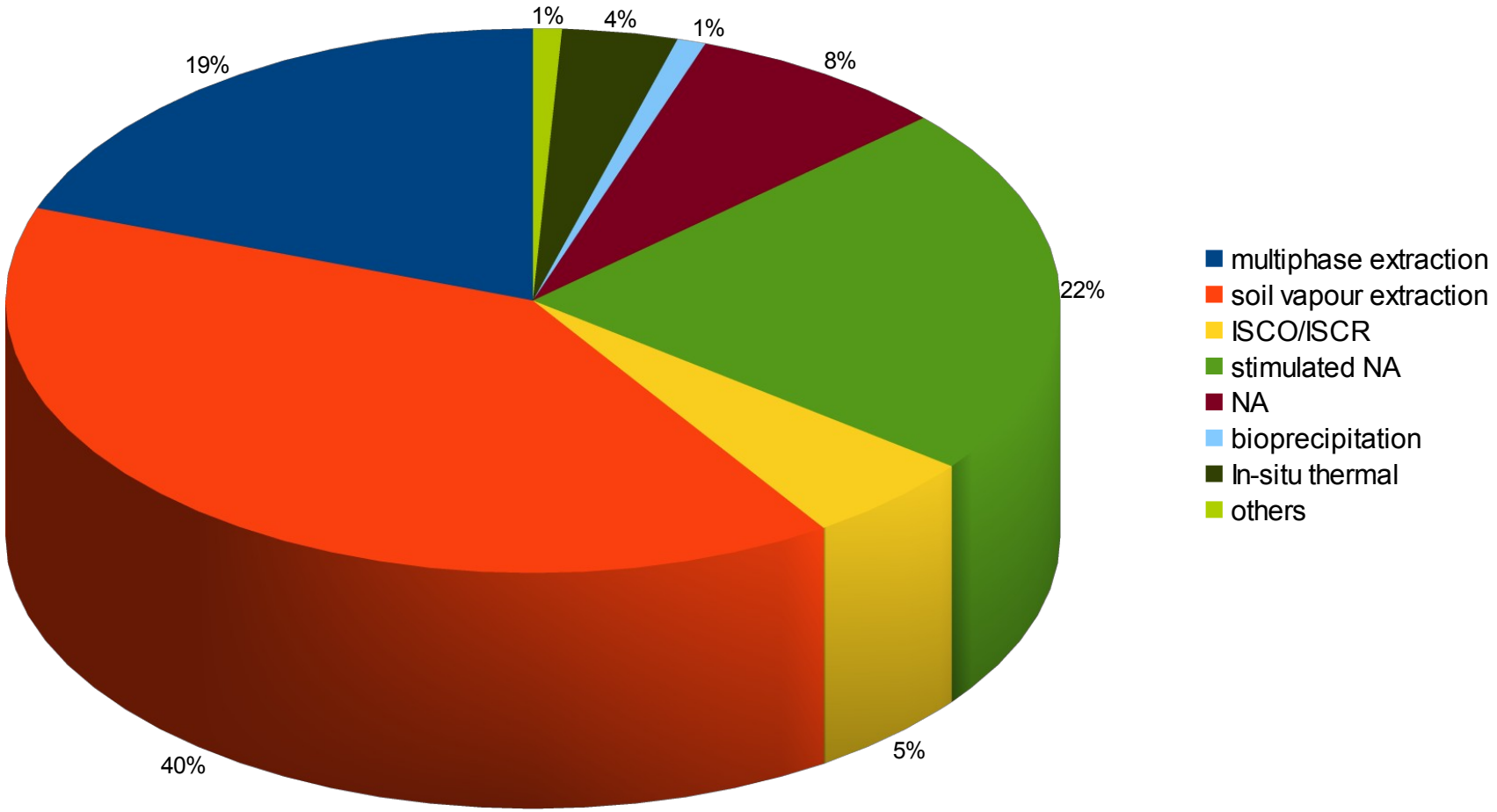
Remediation techniques 2007 - 2012



In-situ remediation techniques 2007 – 2012



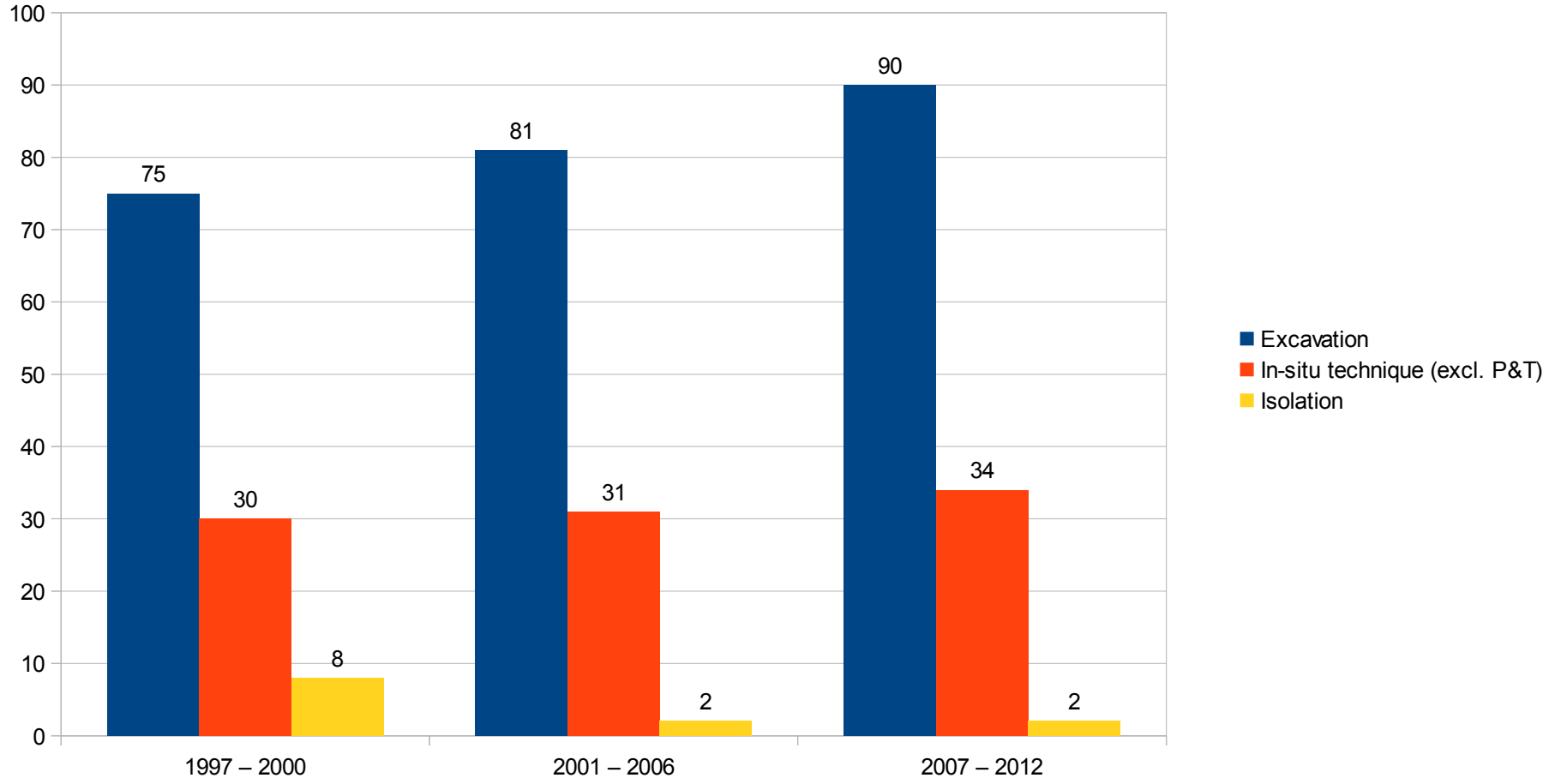
Overview in-situ techniques 2012



Remediation techniques 2007 – 2012: conclusions

- The use of complex in-situ techniques (ISCO) is still increasing
- From NA to stimulated NA
- Combination of different techniques (source – plume approach) for example:
  - Excavation combined with SVE
  - ISCO and stimulated NA
- New in-situ techniques
  - Bio precipitation
  - The injection of zero valent iron (ISCR – 2011)
  - New techniques of in-situ thermal treatment (2012)

Global comparison



The use of heat!

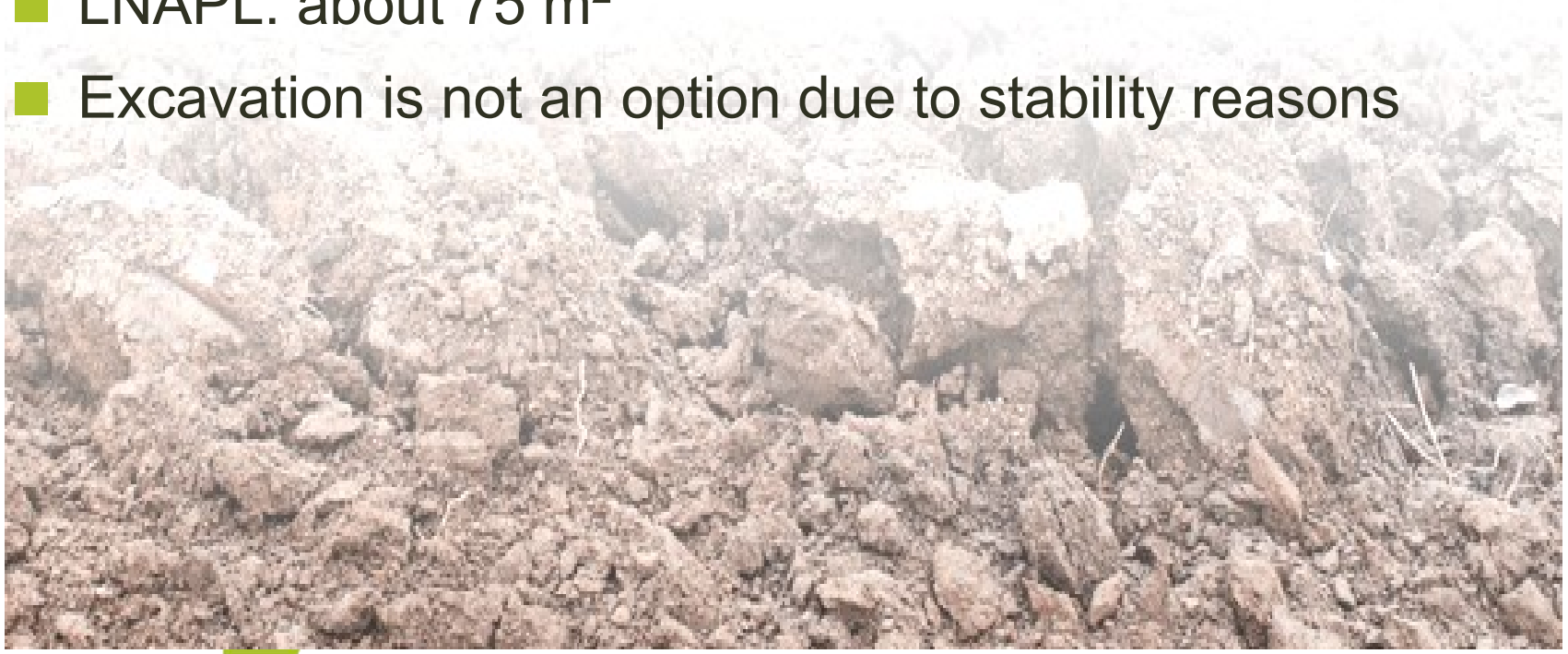
Different techniques using heat to clean up the soil (3 cases):

- Thermal desorption to remove LNAPL in less accessible area's with gas burners
- Heating of the groundwater to increase biodegradation by using solar energy
- Enhanced electrical reductive heating

Case 1: removal of LNAPL

Contamination with gas oil (LNAPL) under a building

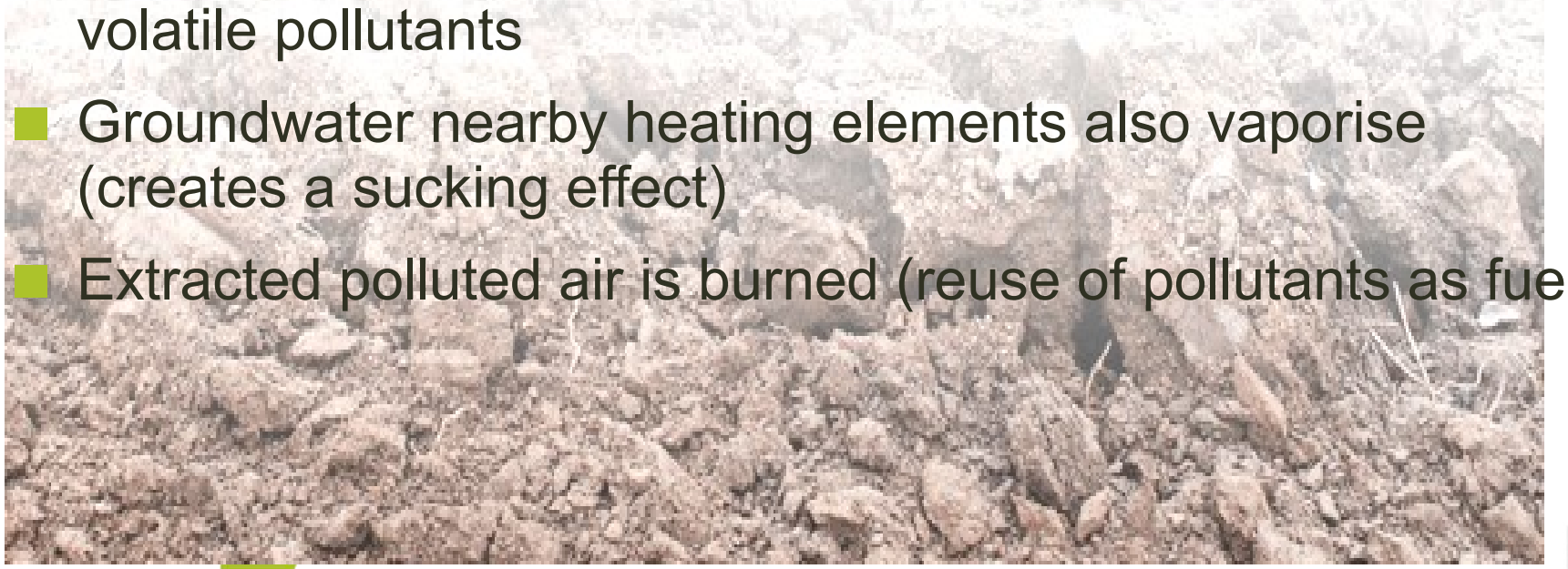
- Loamy soil (low permeability)
- Groundwater: 5 m-bgl
- LNAPL: about 75 m²
- Excavation is not an option due to stability reasons



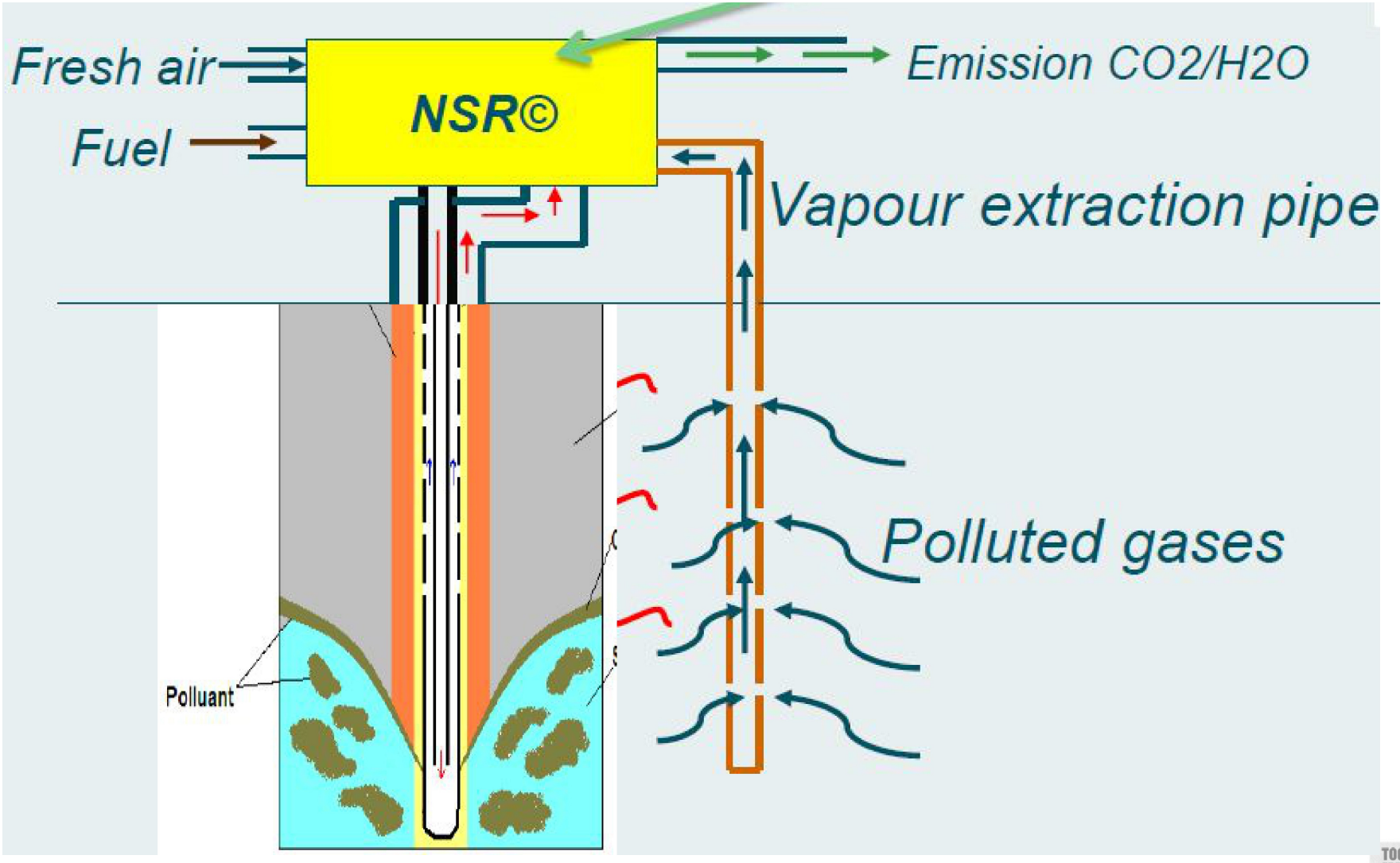
Case 1: removal of LNAPL

Description :

- Individual gas burners create hot air (700°C) and heats the soil by using vertical in-situ heating elements
- The unsaturated zone is heated through conduction and the pollutants vaporise, a soil vapour extraction system extracts the volatile pollutants
- Groundwater nearby heating elements also vaporise (creates a sucking effect)
- Extracted polluted air is burned (reuse of pollutants as fuel)

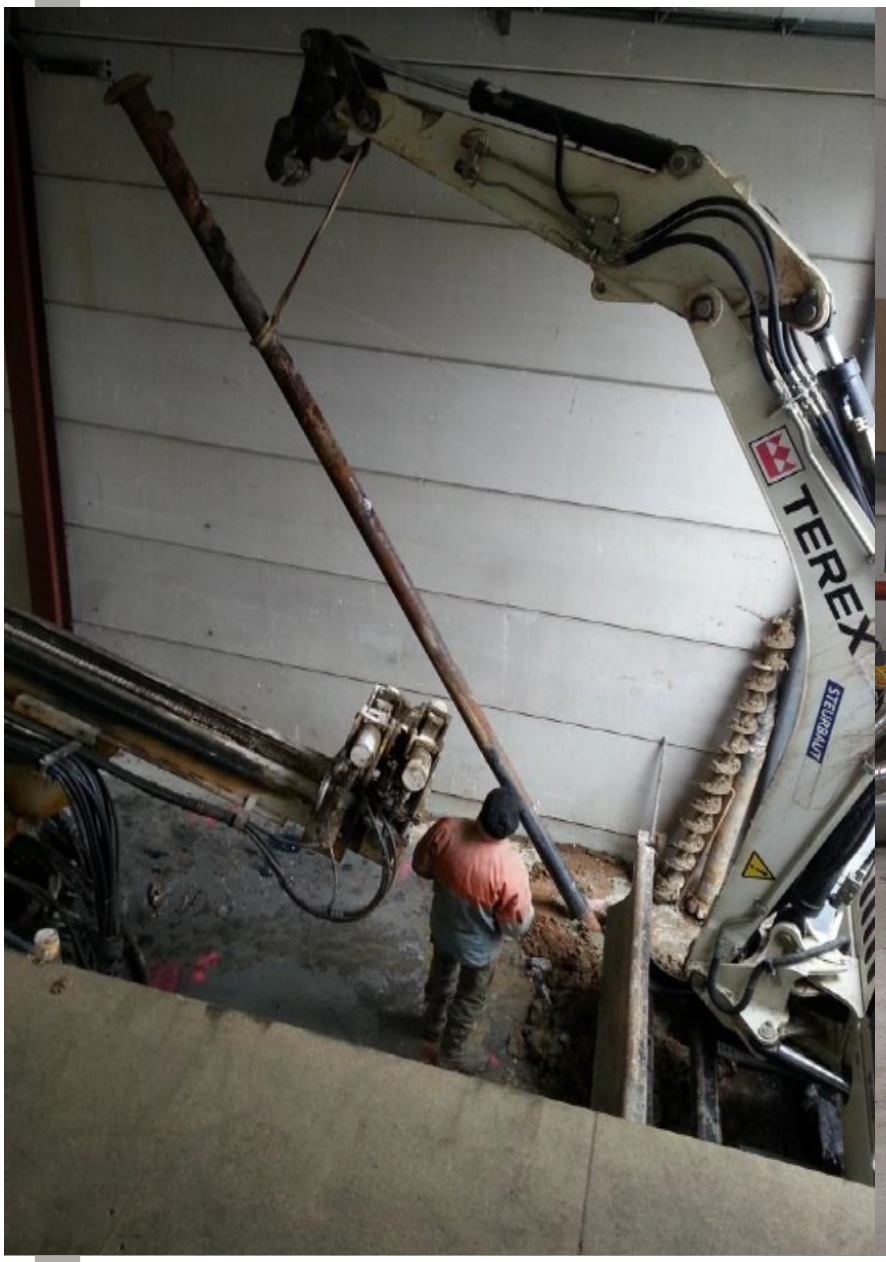


Case 1: removal of LNAPL



Case 1: removal of LNAPL

- Estimated cost: 150.000 euro
- Duration: 6 to 8 weeks
- Results:
  - to reach soil sanitation values in unsaturated soil
  - removal of LNAPL

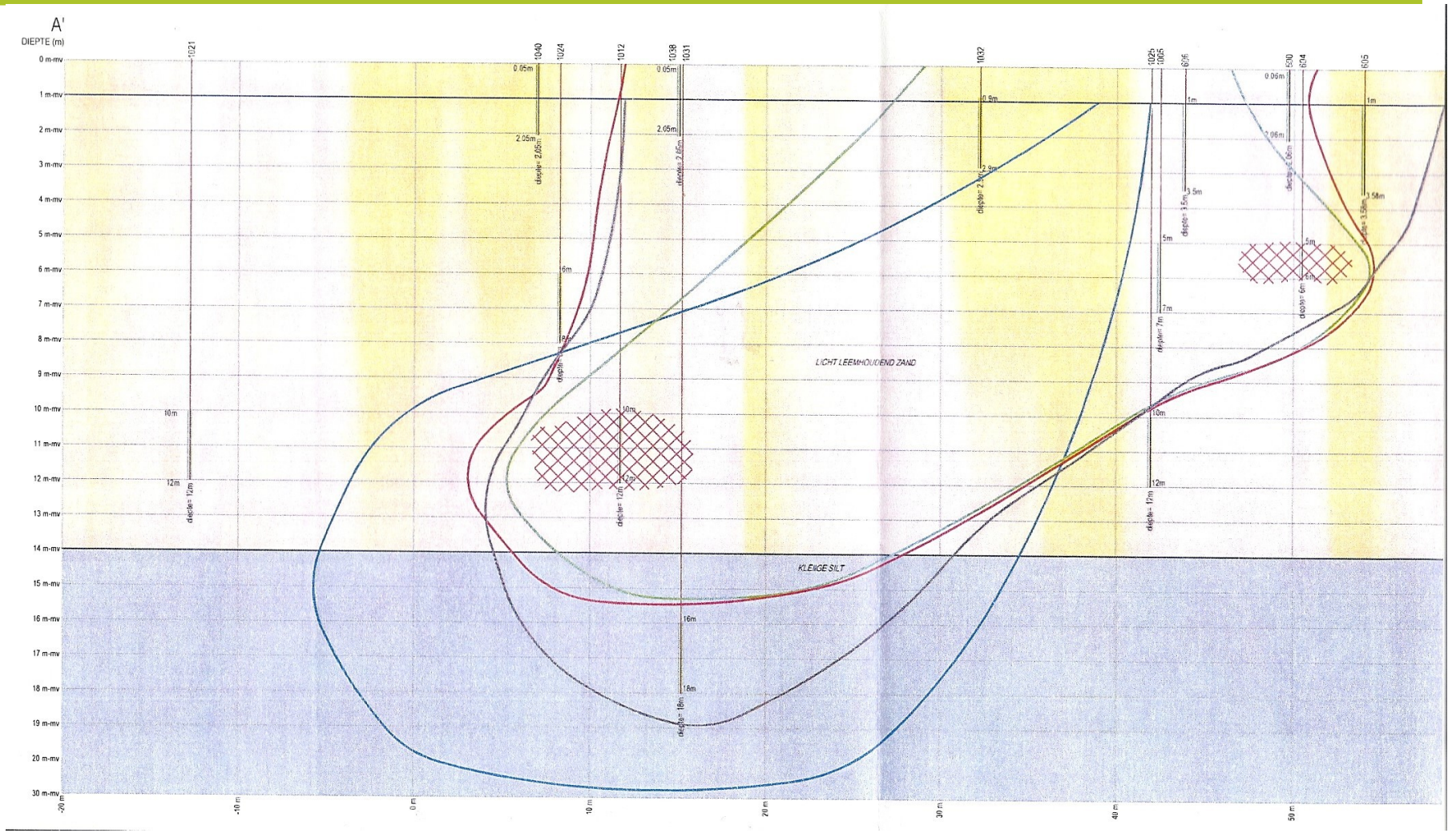


Case 2: stimulation of biodegradation

Contamination with chlorinated solvents (PER) in groundwater:

- 40 000 m³ polluted groundwater
- permeable sand layer, clay layer 14 m-bgl
- groundwaterlevel: 1 m-bgl,
- Based on the groundwater concentrations, possible pure product in the source zone

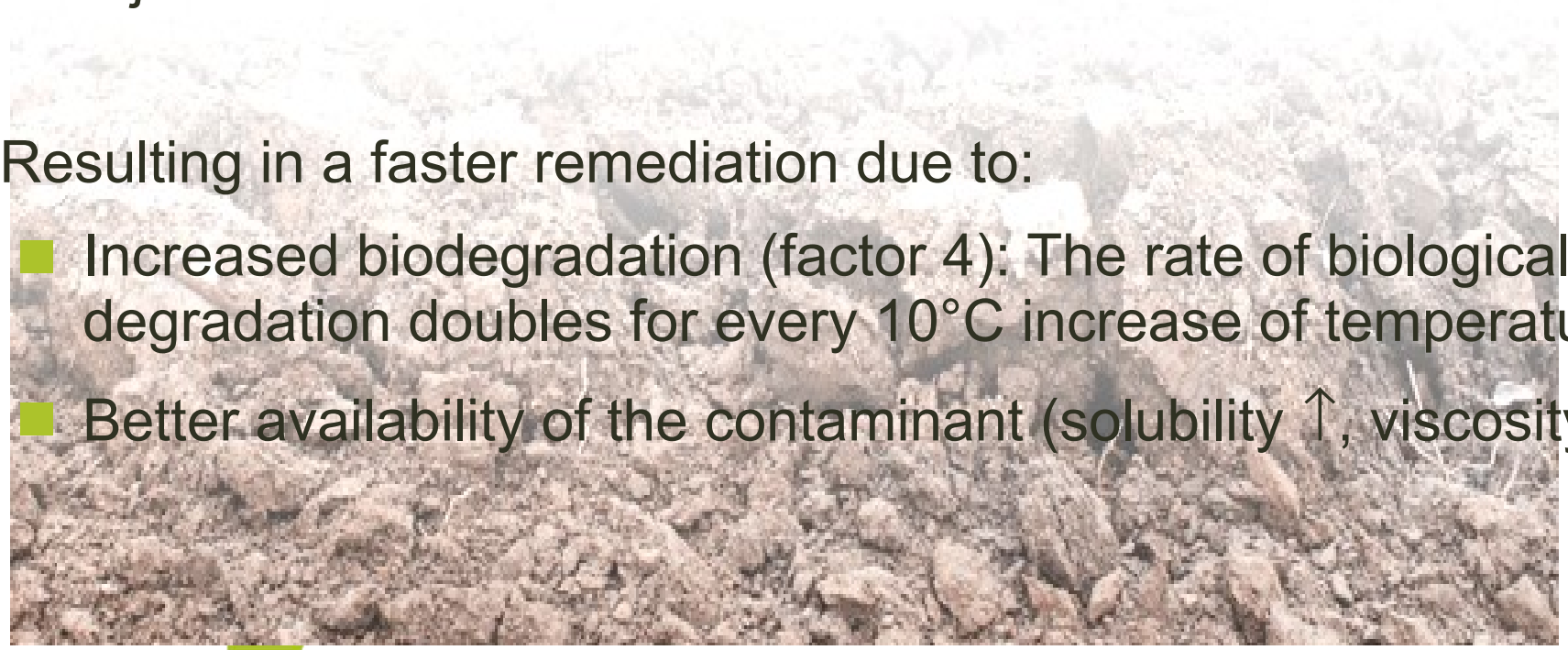
Case 2: stimulation of biodegradation



Case 2: stimulation of biodegradation

Description:

- Warming up the groundwater (from 12°C to 30°C) with in-situ heat exchanger, heat generated by solar collectors
- Injection of C-source and nutrients



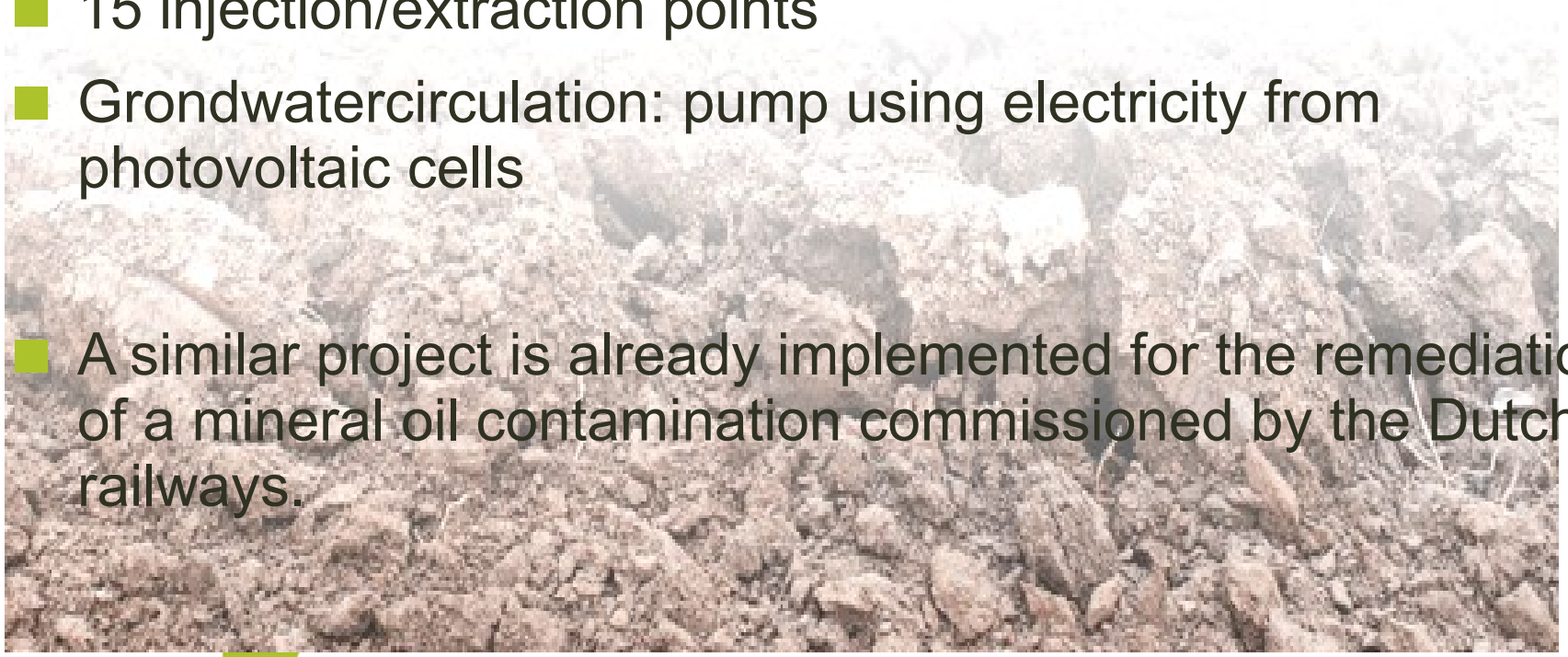
Resulting in a faster remediation due to:

- Increased biodegradation (factor 4): The rate of biological degradation doubles for every 10°C increase of temperature.
- Better availability of the contaminant (solubility ↑, viscosity ↓)

Case 2: stimulation of biodegradation

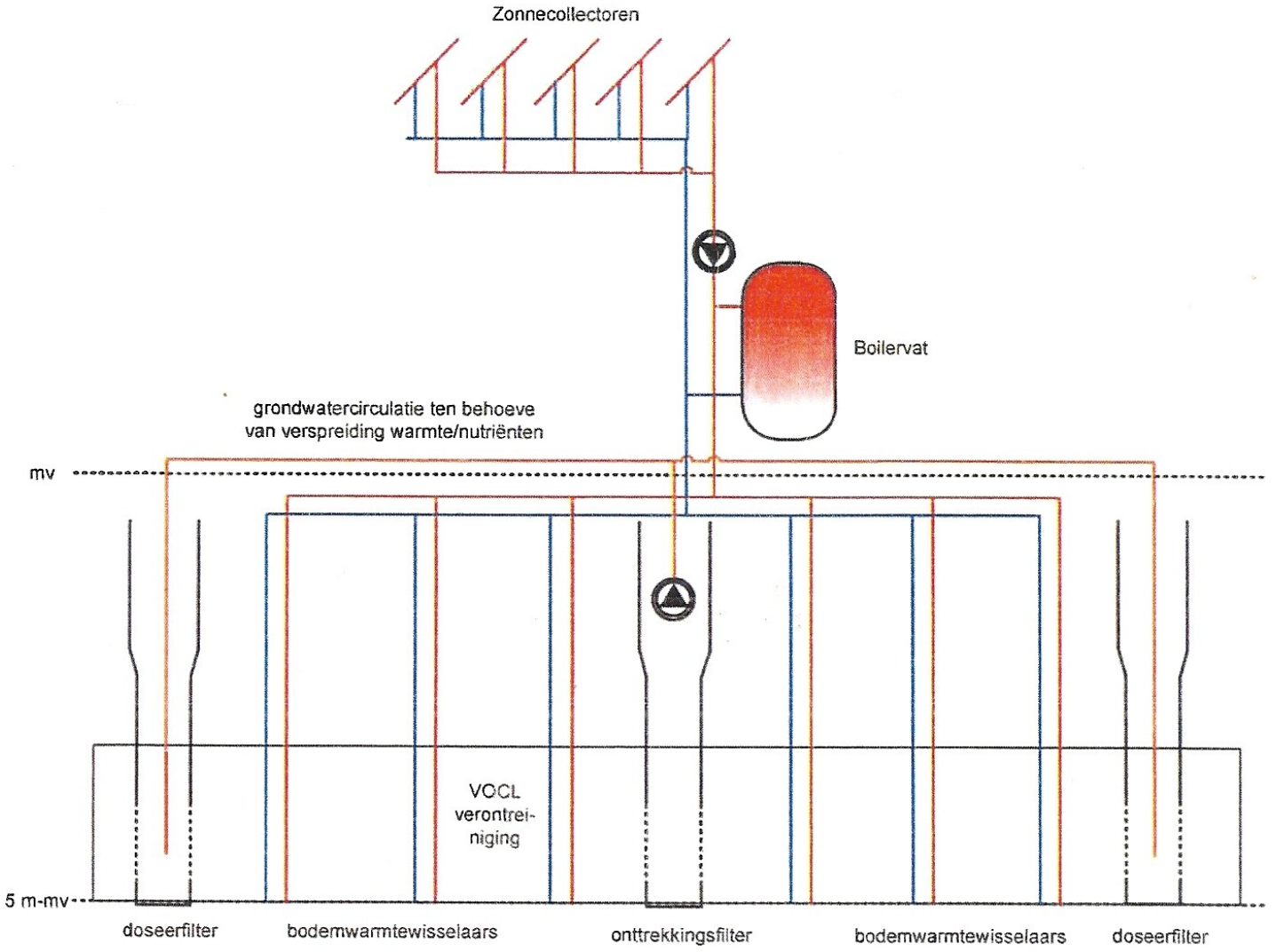
Technical aspects:

- 420 m² LT solar collectors
- 31 vertical in-situ heat exchangers (depth 10 – 13 m-bgl)
- 15 injection/extraction points
- Grondwatercirculation: pump using electricity from photovoltaic cells



- A similar project is already implemented for the remediation of a mineral oil contamination commissioned by the Dutch railways.

Case 2: stimulation of biodegradation

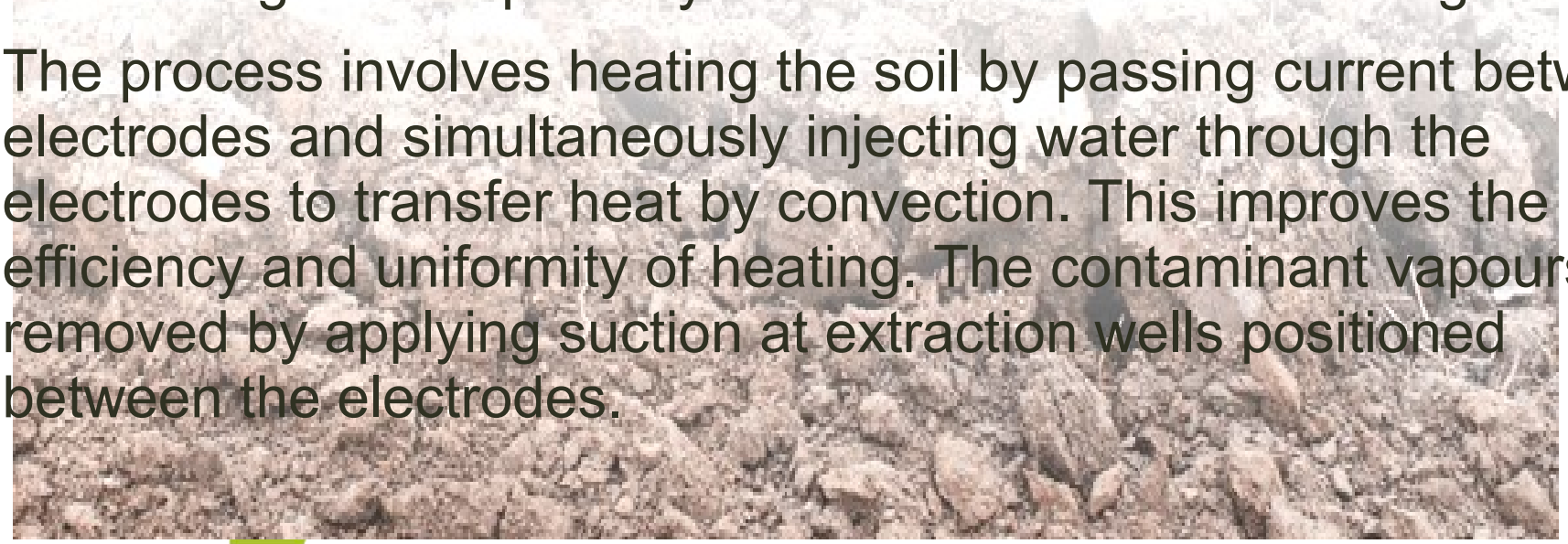


Case 3: Enhanced electrical reductive heating

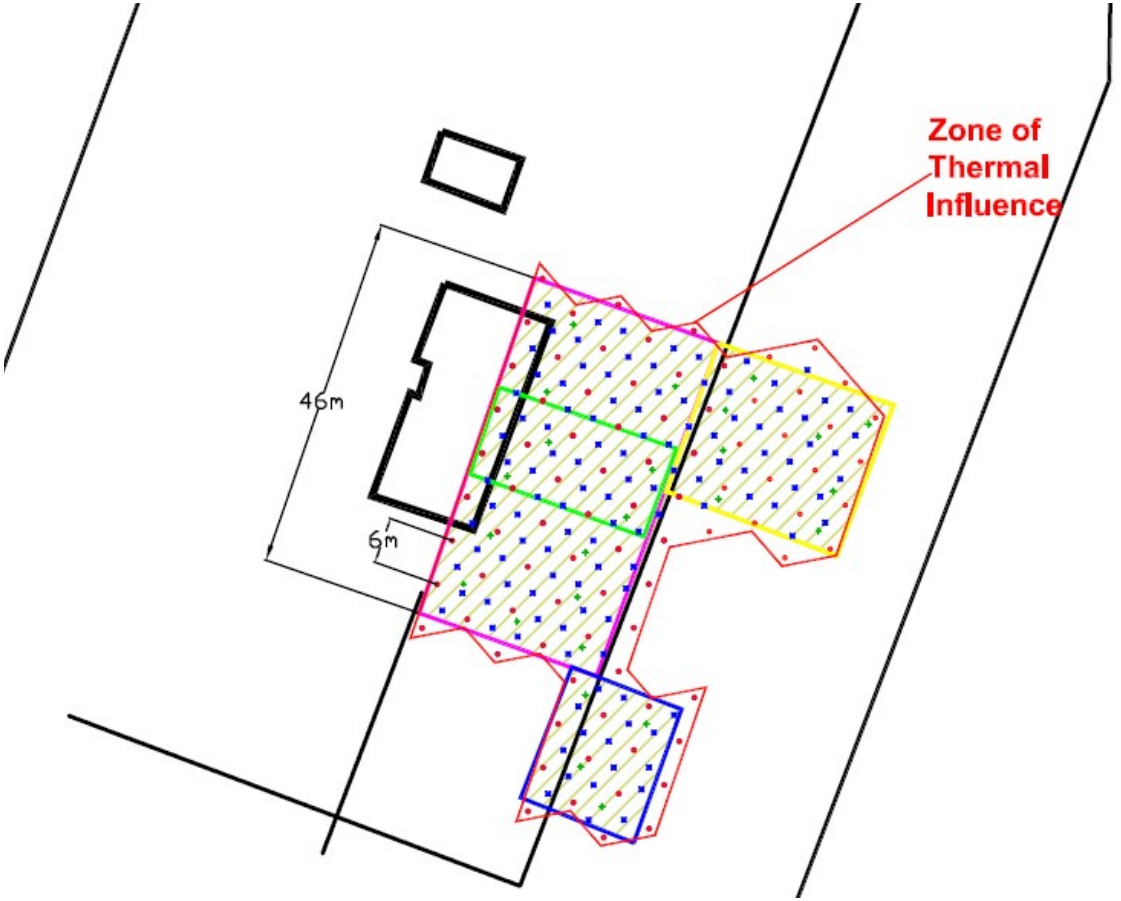
Contamination with creosote (pure product) in ground and groundwater from the former creosote plant that operated until 1984:

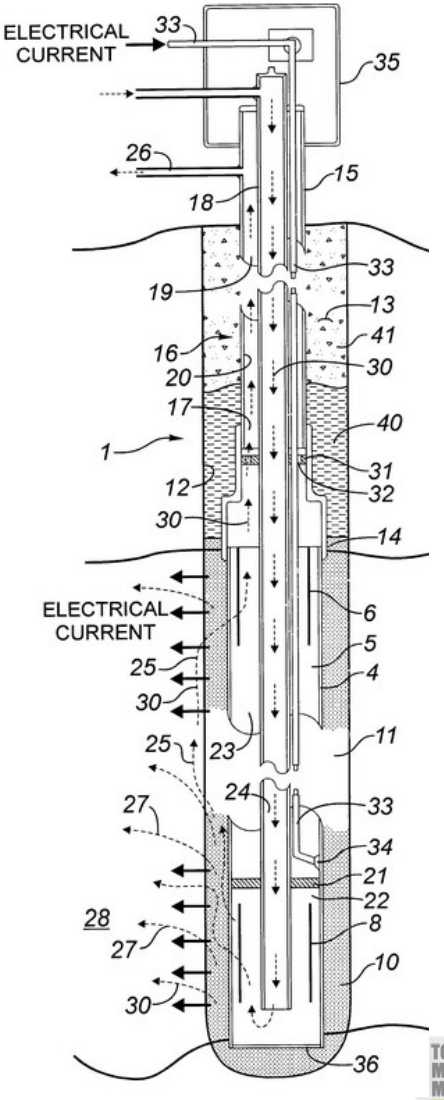
- Contaminated zone: about 1900 m², depth until 15 m-bgl
- Including contaminated peat layer between 5 and 7 m-bgl,
- Drainage of the peat layer will result in serious settings

The process involves heating the soil by passing current between electrodes and simultaneously injecting water through the electrodes to transfer heat by convection. This improves the efficiency and uniformity of heating. The contaminant vapours are removed by applying suction at extraction wells positioned between the electrodes.



Case 3: Enhanced electrical reductive heating





Case 3: Enhanced electrical reductive heating

Technical aspects:

- 84 heating electrodes
- 117 extraction points

- Average groundwater temperature: between 80-90 °C
- Average temperature unsaturated zone: 180 °C

- Estimated cost: 3 500 000 euro
- Estimated duration: 17 months

Trends for the future

- The further development and use of complex in-situ techniques
- Pursuit of more sustainable remediation (CO_2 calculator)
- Improved injection techniques (MIP-IN, stabilisation of Fe°)
- Improved research methods (EnISSA)
- Improving the legislative (creating more legal instruments), to stimulate people to remediate (even in complex situations)
  - Co-financing
  - Mixed pollutants / responsibilities

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