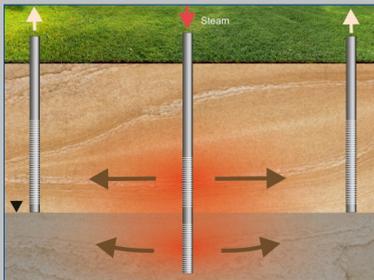
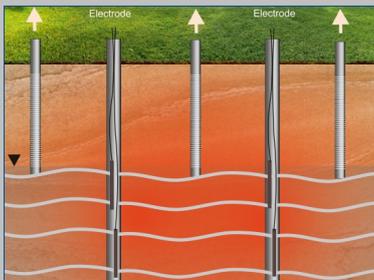


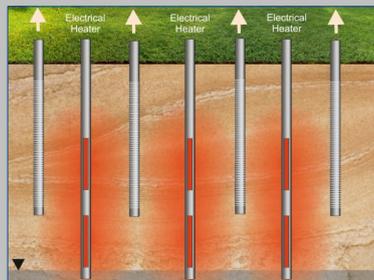
## Thermal



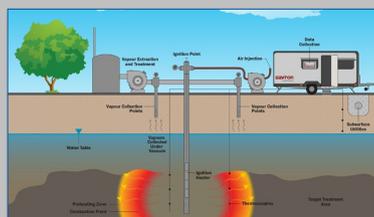
Steam Enhanced Extraction



Electrical Resistance Heating



Thermal Conduction Heating



Star/StarX Smouldering Combustion

## Our Thermal Remediation Technologies

Together with our teaming partners, Cornelsen has undertaken more thermal remediation projects and the widest range of thermal technologies than any other UK Company.

Our projects have been undertaken in the **UK, Germany, Italy & France**

- ◆ **Steam Enhanced Extraction (SEE):** Injection of steam through the formation;
- ◆ **Electrical Conduction Heating (TCH):** Delivery of electricity to the subsurface generating heat through resistance;
- ◆ **Thermal Conduction Heating (TCH):** Direct heating of the subsurface via convection from heaters installed in boreholes; and
- ◆ **STAR/STARx:** In-Situ/Ex-situ Smouldering Combustion

### Benefits of Thermal

- ◆ Heat solves the matrix diffusion problem
- ◆ Proven in bedrock, vadose and saturated soils
- ◆ Fast = 3 to 6 months
- ◆ No rebound and continued decline
- ◆ Combines easily with other remedial technologies
- ◆ Hydrolysis
- ◆ > 99% removal typical
- ◆ Plume remediation outside the treatment zone

### Heat Enhanced Processes

- ◆ Hydrolysis
- ◆ Mass Transfer
- ◆ Enhanced biodegradation
- ◆ Speeds biotic and abiotic reactions
- ◆ Mobilisation and recovery of heavy oils through viscosity reduction



## Steam Enhanced Extraction (SEE)



Delivery of steam or steam/air via injection wells

**Rapid, lower cost heat propagation through permeable formations**

- ◆ Effective in vadose zone and saturated zone
- ◆ Lower Energy Costs
- ◆ Suits large scale sites

## Thermal Conduction Heating (TCH)



Direct conductive heating via heater wells

**High temperature solution that exceeds the boiling point of SVOC compounds**

- ◆ Also suitable for VOCs, PCBs and PFAS
- ◆ Combines well with steam/air injection & ERH
- ◆ Proven in crystalline rock

## Electrical Resistance Heating (ERH)



Electrical energy to the subsurface via electrodes.

**Low permeability = more resistance = more heat NAPL = more electrical conductivity = more heat**

- ◆ Effective in vadose zone & saturated zone
- ◆ Ideal for heterogeneous formations
- ◆ Most Energy efficient
- ◆ Saturation is advantageous
- ◆ Easiest to control and shut down

## STAR/STARx Smouldering Combustion



STAR and STARx – Smouldering combustion.

**Exothermic reaction converting carbon compounds to  $CO_2$  +  $H_2O$**

- ◆ High calorific, low volatility and low mobility contaminant such as coal tar
- ◆ Effective in vadose zone and saturated zone
- ◆ Complete destruction of contaminants / organic wastes. Little to no wastes generated
- ◆ Treated materials may be beneficially reused on site
- ◆ Low-energy, sustainable technique for the rapid destruction of contaminants