



## EKO/GRID Soil & Water Treatment

Using Electro Kinetic and Electro Chemical reactions to remove organic pollutants in soil, sludge and ground water

EKO/GRID Soil & Water Treatment

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## EKO/GRID Soil & Water Treatment



### EKO/GRID Soil & Water Treatment

The EKO/GRID Soil & Water treatment utilizes an innovative technology to break down hydrocarbons into water and carbon dioxide.

EKO/GRID is the most cost-effective and environmentally-sensitive treatment method available anywhere today.

LAMOR has been involved in remediation projects in Turkey, Finland, China, Brazil, Ecuador, Peru, and Colombia.

GRIFFIN and LAMOR will be installing a system in Quebec in the spring of 2017.





## EKO/GRID Soil & Water Treatment



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### Range of Applications

Effective on all hydrocarbons

World's most ecologically friendly  
remediation – suitable for Amazon Rain  
Forest

Great scalability

Effective at considerable depths

- 1. Sludge
- 2. Surface & Groundwater
- 3. Soil, Sand, & Clay

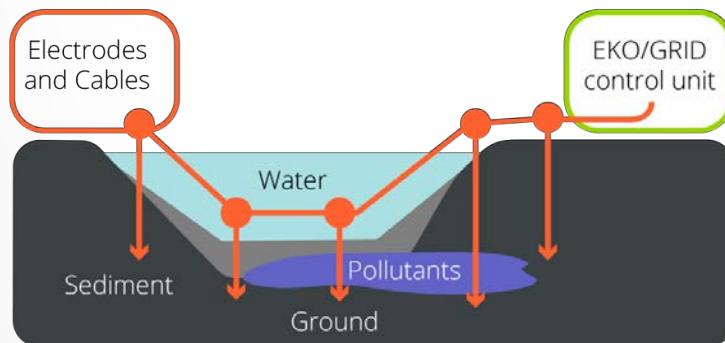




### The EKO/GRID System

EKO/GRID™ is an in situ system, which removes many costs of other treatment methods.

An EKO Control Unit sends optimized, pulsed voltage patterns to a grid of steel electrodes, creating an electrokinetic field in the treatment area.

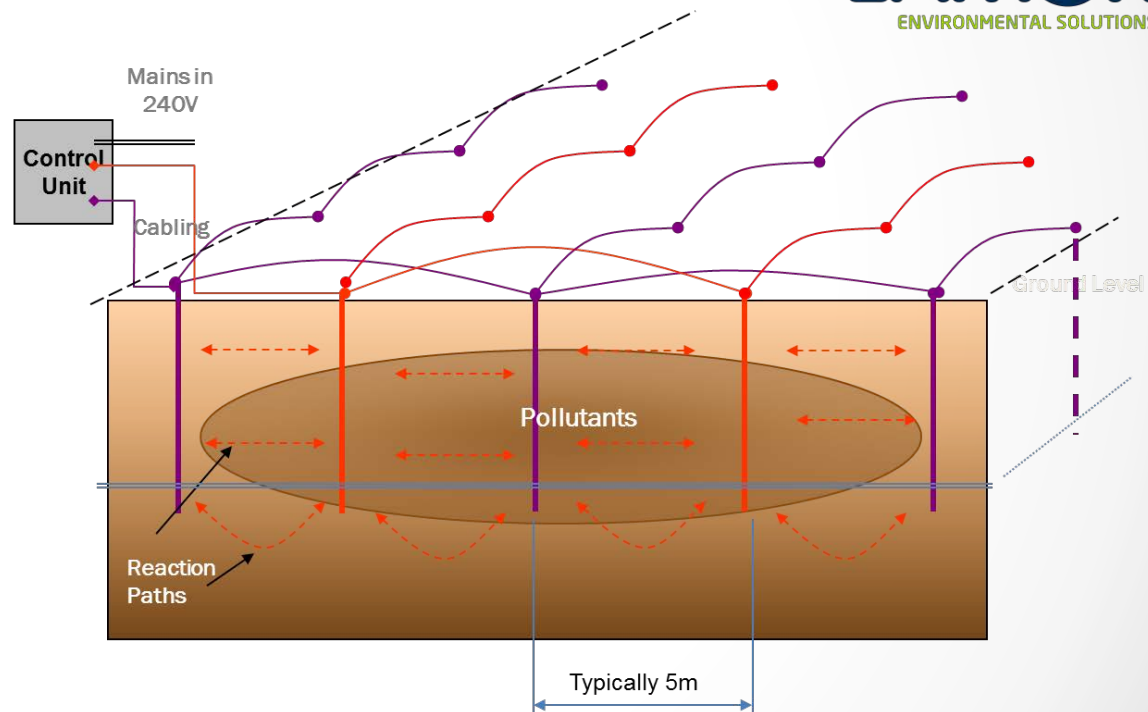


### EKO/GRID Soil & Water Treatment

The patented EKO/GRID™ Technology uses Electro Kinetic and Electro Chemical reactions to remove organic pollutants in soil, sludge and ground water.

The optimised pulsed voltage patterns, essential to the success of this system, are transmitted by a **bespoke EKO Control Unit**.

Electro Kinetic field is created using a series of steel electrodes which are installed in the treatment area.





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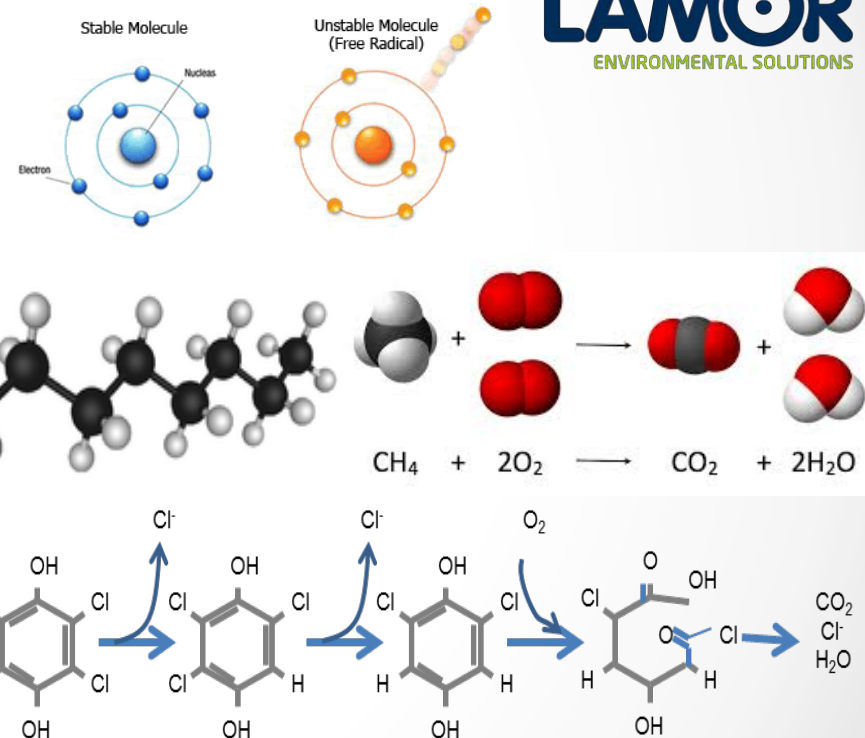
### EKO/GRID Soil & Water Treatment

The patented pulsing voltage/current output creates redox reactions on the pore surfaces.

Freshly formed oxygen and hydroxyl radicals from these reactions will oxidise and split hydrocarbon chains and rings into lighter fractions. The end creating carbon dioxide and water as end products.

The oxidization conditions increase microbiological activity, which is critical to the success of the enhanced bioremediation process.

The enhanced bioremediation process is well known and understood within the remediation industry, as it is the same as other existing technologies which add oxidizing chemicals and/or substances to the site.

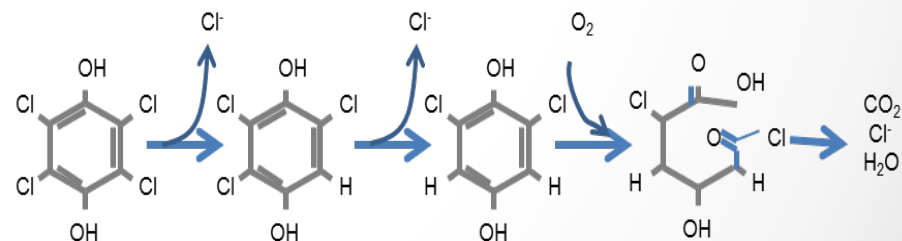
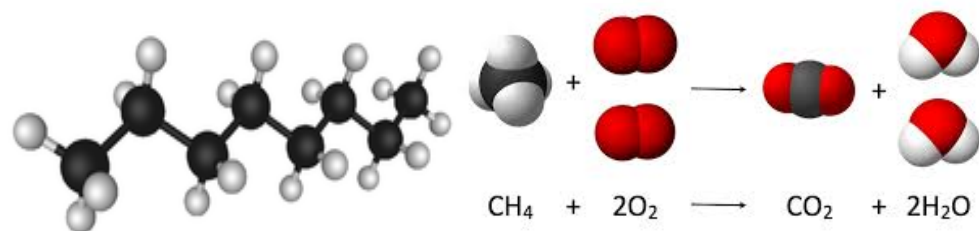
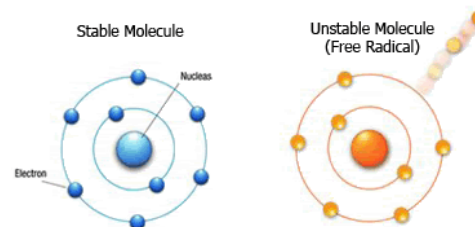


### EKO/GRID Soil & Water Treatment

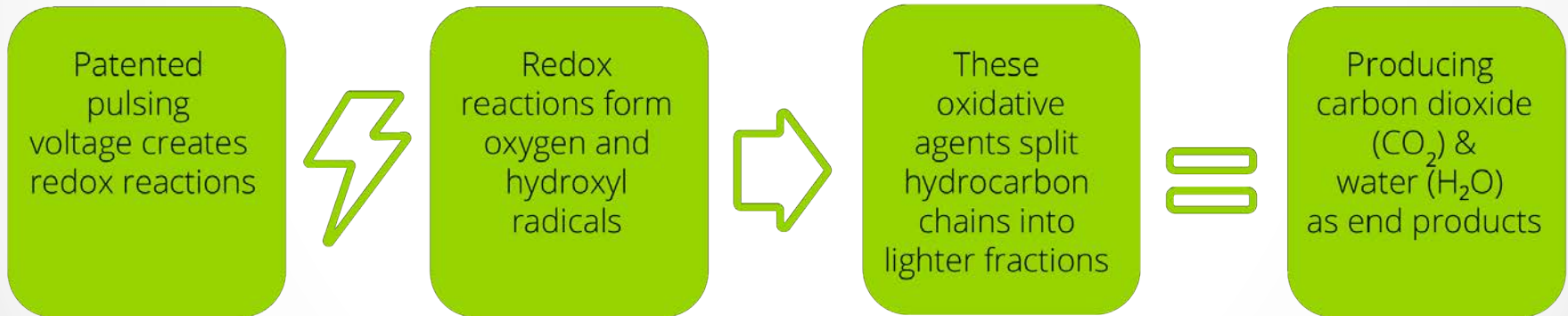
#### Legend

$\text{CH}_4$  = Methane  
 $2\text{O}_2$  = Two moles of Oxygen  
 $\text{CO}_2$  = Carbon Dioxide  
 $2\text{H}_2\text{O}$  = Two moles of water  
 $\text{Cl}$  = Chlorine  
 $\text{OH}$  = Hydroxide  
 $\text{H}$  = Hydrogen  
 $\text{O}_2$  = Oxygen  
 $\text{H}_2\text{O}$  = Water

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## EKO/GRID's Electro Kinetic Oxidation







## EKO/GRID Soil & Water Treatment

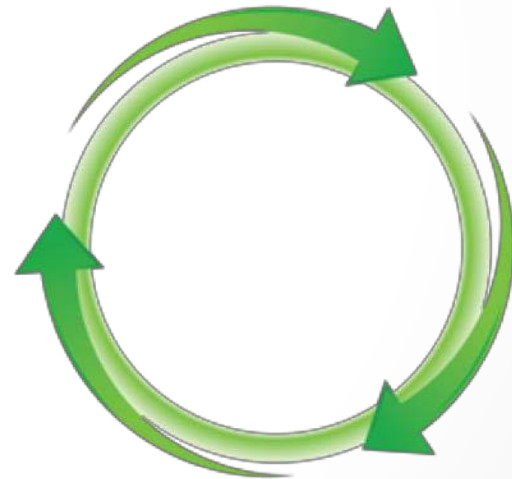


### Minimal Ecological Footprint

The EKO/GRID system is non-harmful to plant & animal life.

Unlike other treatment technologies,  
the EKO/GRID System offers:

- No chemical additives
- No additional soil
- No Carbon Emissions from transporting waste
- Minimal Electricity required, and can be powered by either Solar or Wind.



## Cost Effective

**EKO/Grid is an economically superior method:**

### **Low CAPEX**

- Low-cost system of steel grid and pulse generator
- Quick and simple installation

### **Low OPEX**

- Modest electricity consumption (even solar or wind power)
- No waste transportation costs
- No storage costs
- No on-site staffing; continuous remote monitoring

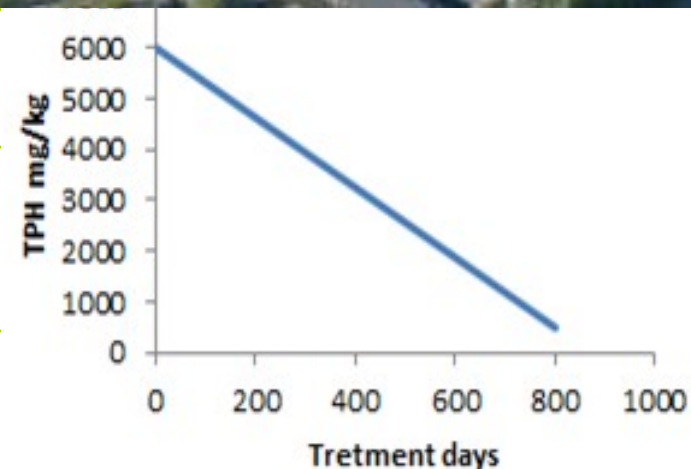




## Case Study #1: Finland (2012)

### Remediation of Aliphatic Hydrocarbons

Site Conditions	<ul style="list-style-type: none"> <li>Area is mainly silt or fine sand</li> <li>A 10 to 50 cm thick peat layer lies as deep as 1 m</li> <li>Ground water level 2.5 m below surface level</li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>Mainly Diesel fractions C10-C21</li> <li>A smaller amount of heavier fractions C21-C40</li> <li>Max THC (C10-C40) measured &gt;100,000 mg/kg</li> <li>Treated volume was approximately 15,000 m<sup>3</sup></li> </ul>
Results	<ul style="list-style-type: none"> <li>Treatment was stopped when 90% of the treated area reached the target level of 1,000 mg/kg</li> </ul>



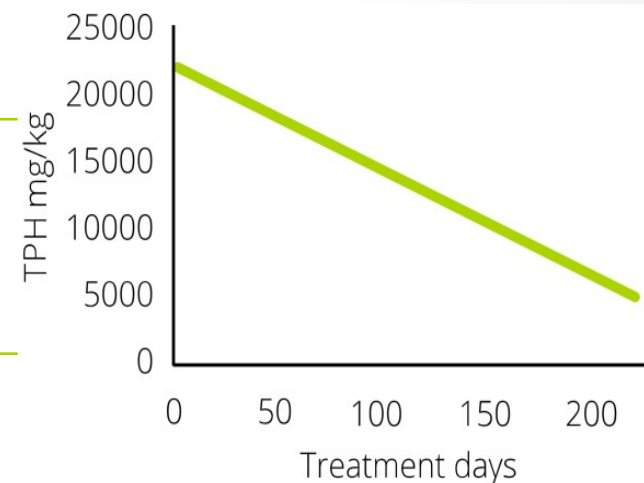


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## Case Study #2: Ecuador (2014)

### Remediation of Drilling/Tank Bottom Sludge

Site Conditions	<ul style="list-style-type: none"> <li>The treatment pool contains tank bottom sludge and other heavy API class waste</li> <li>0.5 to 1 m of water on the top</li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>Typical crude oil based drilling sludge for South America containing bituminous lumps of oil</li> <li>The TPH (EPA 166 4- Gravimetric method) in the beginning was approximately 25%.</li> <li>Treated volume is approximately 800 m<sup>3</sup></li> </ul>
Results	<ul style="list-style-type: none"> <li>In four months 70% of the hydrocarbons have been removed..</li> </ul>



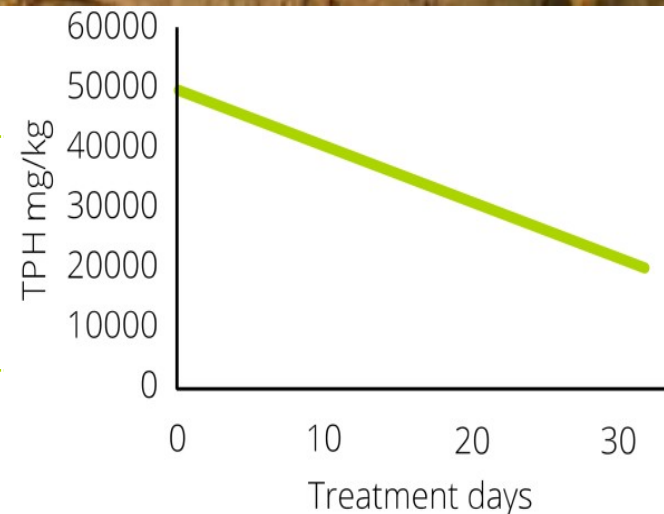




## Case Study #3: Colombia (2014)

### Remediation of Tank Bottom Sludge

Site Conditions	<ul style="list-style-type: none"> <li>The treatment pool has a volume of 800 m<sup>3</sup></li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>Typical crude oil sludge for Colombia containing very heavy fractions of aliphatic hydrocarbons combined with bituminous lumps of oil</li> <li>The TPH in the beginning was approximately 36%</li> <li>Treated volume is approximately 800m<sup>3</sup></li> </ul>
Results	<ul style="list-style-type: none"> <li>Significant decrease in the level of TPH with both infrared spectroscopy and gas chromatography during the first 50 days</li> </ul>

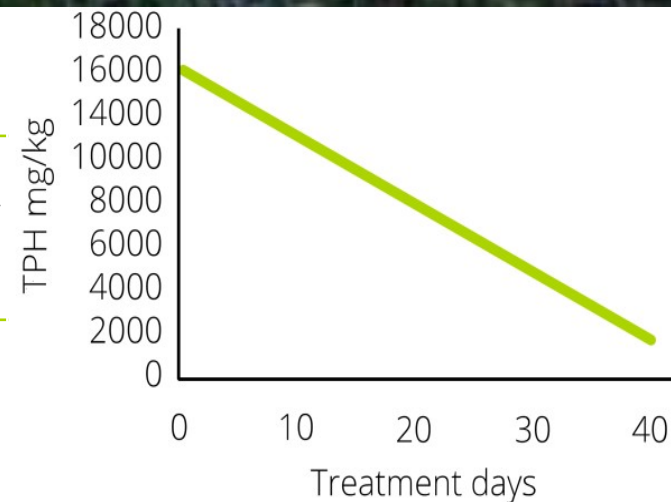




## Case Study #4: Ecuador (2014)

### Remediation of Oil Spill Contaminated Soil

Site Conditions	<ul style="list-style-type: none"> <li>The contaminated area is slightly more than 2,000 m<sup>2</sup></li> <li>The depth of the pollution can reach up to 4 m</li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>Medium-length fractions of aliphatic hydrocarbons</li> <li>TPH levels varies from 2,500 – 35,000 ppm depending on the location.</li> <li>Treated volume approximately 6,000 m<sup>3</sup></li> </ul>
Results	<ul style="list-style-type: none"> <li>Treatment time is estimated to be from 9 to 12 months.</li> </ul>





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## Case Study #5: Brazil (2014)

### Remediation of Polycyclic Aromatic Hydrocarbons

Site Conditions	<ul style="list-style-type: none"> <li>• A train terminal with a repair facility for cargo train cars</li> <li>• Most of the pollution has evolved over the past 30 years</li> <li>• The ground water is 35 centimeters deep</li> <li>• There is a strong tidal wave in the area as well a lot salinity</li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>• The pollution level of benzo(a)pyrene was initially 252% over the permitted level.</li> </ul>
Results	<ul style="list-style-type: none"> <li>• Custom design of the grid and the sampling procedure to account for tidal wave factors.</li> <li>• Decrease of 95% of contaminants during the first 30 days. This result is in line with previous results for treating PAHs.</li> <li>• However, in order to account for the heavy tidal current in the area, the treatment was continued for another 30 day period as a precautionary procedure.</li> </ul>







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## Case Study #6: Peru (2014-2015)

### Remediation of Oil Spill Contaminated Soil

Site Conditions	<ul style="list-style-type: none"> <li>• Amazonian jungle in Northern Peru</li> <li>• Oil spilled into the Marañón river and surrounding land</li> <li>• Area characterized by the fragile ecosystem, remoteness, high levels of rainfall, and difficulty of access</li> <li>• Treatment area included riverbanks and forest floor</li> </ul>
Pollutants	<ul style="list-style-type: none"> <li>• Primarily heavy crude oil with an API Gravity of 20.8°, including a slight percentage of Nafta 5-10%</li> <li>• Treatment area of 1800 m<sup>2</sup></li> </ul>
Results	<ul style="list-style-type: none"> <li>• After the mechanical recovery and clean-up of 1,604 barrels of crude oil spilled from a ruptured pipeline, the EKO/GRID system was installed to treat the remaining hydrocarbons.</li> <li>• Treatment was stopped when the treatment area reached the target level.</li> </ul>







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**EKO/Grid is the greenest soil & water treatment technology in the world.**

It is the only technology that utilizes a non-additive, in situ, electrokinetic process with guaranteed results.





## EKO/GRID Soil & Water Treatment

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Thank you.  
Questions, comments?

