

# Carbon footprint on soil remediation

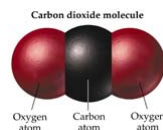
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## Outline presentation

- Reason to develop tool
- $CO_2$  as a sum parameter
- Scope of the tool
- Structure and content of tool
- Experiences so far
- Future scope



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## Reason to develop tool

Reason for tool	Environmental merit of some soil remediation projects seems hard to find (length and/or intensity)
CO <sub>2</sub> as parameter	
Scope of tool	
Design of tool	Companies conform to sustainable entrepreneurship
Experiences	
Future scope	Dutch governments conform to sustainable purchase
	Worldwide attention for climate change and energy topics



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## Reason to develop tool

Reason for tool	<b>"A quantified carbon footprint needs to be part of the multi criteria analysis for soil remediation projects"</b>
CO <sub>2</sub> as parameter	
Scope of tool	
Design of tool	
Experiences	
Future scope	



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## CO<sub>2</sub> as a sum parameter

Reason for tool	A lot of environmental aggravating factors can be expressed in CO <sub>2</sub> :
CO <sub>2</sub> as parameter	
Scope of tool	• use of electricity
Design of tool	
Experiences	• use of fuels
Future scope	• oxidation (CO <sub>2</sub> ) and reduction (CH <sub>4</sub> ) reactions
	• production of materials (Process Energy Requirement) to be used during remediation



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## CO<sub>2</sub> has a market value

Reason for tool CO<sub>2</sub> represents an economic market value (emission trade)

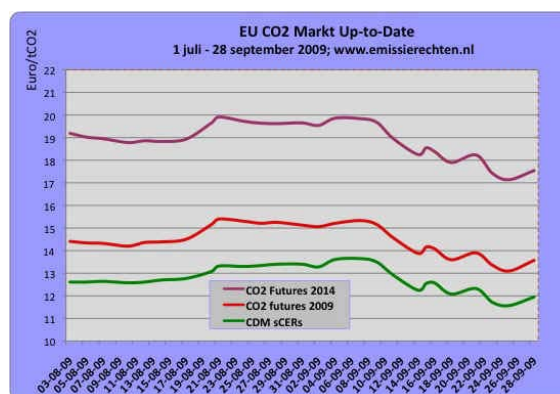
CO<sub>2</sub> as parameter

Scope of tool

Design of tool

Experiences

Future scope



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## Scope of CO<sub>2</sub> tool

Reason for tool

**At what moments do we screen on environmental burden?**

CO<sub>2</sub> as parameter

**Scope of tool**

Design of tool

- Remediation investigation: weighing pros and cons

Experiences

- Tenders: part of allotment criteria D&C contracts

Future scope

- Compensation total CO<sub>2</sub>-emission of the work

- Stop criterion operational in situ remediation



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## Development by consortium

Reason for tool

The model is broadly based

CO<sub>2</sub> as parameter

**Scope of tool**

Consultants (Ecofys, Tauw)

Design of tool

Contractors (Heijmans, Groundwater Technology)

Experiences

Soil remediators (Province Overijssel, SBNS, City Groningen)

Future scope

SKB

(Dutch Centre for Soil Quality Management and Knowledge Transfer)



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## Design of tool

Reason for tool	Model in MS Excel
CO <sub>2</sub> as parameter	
Scope of tool	Input screen with folding subscreens
<b>Design of tool</b>	<b>3 Databases with quantitative resources</b>
Experiences	
Future scope	Calculation screen
	Output screen with quantitative and graphical results



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## CO<sub>2</sub> components in tool

Reason for tool	Several fuels (incl. production, handling, combustion)
CO <sub>2</sub> as parameter	
Scope of tool	Various forms of electricity (no zero emission)
<b>Design of tool</b>	
Experiences	
Future scope	Material (PER-values, non-machinery, application period)
	Oxidation & reduction (chemical, biological, thermal)



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## Limits of tool

Reason for tool

**What is not in the tool?**

CO<sub>2</sub> as parameter

Scope of tool

**Design of tool**

Other environmental issues like noise, smell and residues in soil after remediation

Experiences

Future scope

Non-environmental issues like costs, risk reduction and technical feasibility



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## Soil remediation techniques in tool

Reason for tool

- Excavation of soil, incl. treatment

CO<sub>2</sub> as parameter

- Extraction of groundwater

Scope of tool

- Purification of groundwater

**Design of tool**

- Air sparging and SVE

Experiences

- Multi-phase extraction

Future scope

- ISCO

- In situ biostimulation

- In situ thermal treatment

- Supervision and monitoring

Technique > activity > unit > value



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# Impression input screen

## Algemene gegevens verontreinigingssituatie

### Verontreinigingsomvang van de sanering

m<sup>3</sup> grond

m<sup>3</sup> grondwater

### Verontreinigde bodemlaag/lagen

m -mv (bovenkant verontreinigde laag grond)

m -mv (onderkant verontreinigde laag grond)

### Verontreinigde grondwaterlaag/lagen

m -mv (bovenkant verontreinigde laag grondwater)

m -mv (onderkant verontreinigde laag grondwater)

### Gemiddeld gehalte verontreiniging

mg/kg ds grond

µg/l grondwater

### Terugsaneerwaarde/eindgehalte

mg/kg ds grond

µg/l grondwater

▼ ▲ Ontgraven Landbodem

▼ ▲ Grondwater onttrekken

▼ ▲ Grondwater zuiveren

▼ ▲ In situ saneren PLI en BLE

▼ ▲ In situ saneren MFE

▼ ▲ In situ saneren ISCO

▼ ▲ In situ saneren Biostimulatie

▼ ▲ In situ saneren Thermisch

▼ ▲ Toezicht en Nazorg

▼ ▲ Overige varianten



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# Impression input screen

## ▼ ▲ Ontgraven Landbodem

### ▼ ▲ Ontgraven en verwerken grond op de locatie in depot

Volume te ontgraven verontreinigde grond

m<sup>3</sup>

Toepassing graafmachine

m<sup>3</sup>

Toepassing dumper

m<sup>3</sup>

Kies berekeningswijze

Zelf details invoeren

Toepassing shovel

m<sup>3</sup>

Geef aan hoeveel in depots c.q. grondstromen de ontgraven grond wordt gesplitst

depot(s)

Worden de depots voorzien van scheidende laag d.m.v. folie?

<< maak keuze >>

Maximale depot hoogte

m

Geotextiel / folie

Type kunststof

<< maak keuze >>

Benodigde hoeveelheid

m<sup>2</sup>

Dikte geotextiel / folie

mm

Kies type brandstof in kader van duurzaamheidsaspecten

<< maak keuze >>

▼ ▲ Toepassen van een damwand

▼ ▲ Op de locatie verwerken grondstromen

▼ ▲ Extern verwerken grondstromen

▼ ▲ Overige materialen

▼ ▲ Transport grondstromen

▼ ▲ Transport aanvoer materialen



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# Impression output screen

<b>Excavation soil</b>	<b>9.609.004 kg CO<sub>2</sub></b>
Excavation	893.134 kg CO <sub>2</sub>
Treatment	8.265.508 kg CO <sub>2</sub>
Materials	78.011 kg CO <sub>2</sub>
Transport	372.351 kg CO <sub>2</sub>

**Removed contaminant mass** 155.728 kg  
**Treated soil volume** 315.000 m<sup>3</sup>

**EMISSION :** 10.429.817 kg CO<sub>2</sub>  
 1.146,1 household equivalents  
 67 kg CO<sub>2</sub> per kg removed contaminants  
 33 kg CO<sub>2</sub> per m<sup>3</sup> contaminated soil

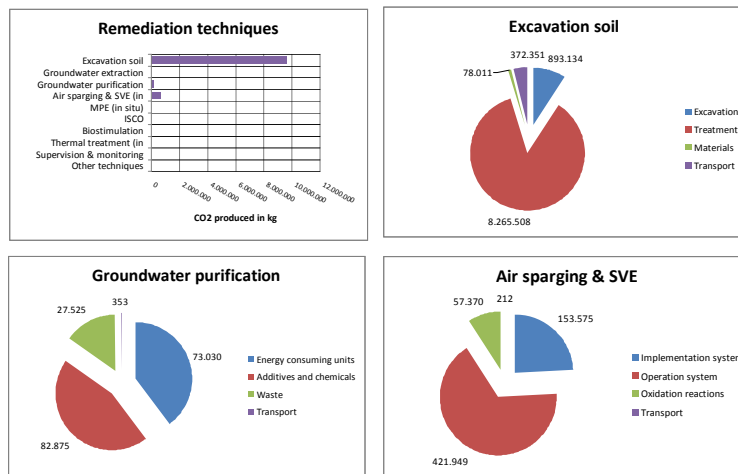


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# Impression output screen



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## Experiences until now

Reason for tool	Soil remediation up to 1,000 Dutch household eq $CO_2$
$CO_2$ as parameter	
Scope of tool	Off site thermal treatment of soil most extreme $CO_2$ -emitting activity
Design of tool	
Experiences	Transport of material ( <i>excl soil</i> ) and personnel marginal
Future scope	ISCO: production oxidizing chemicals crucial
	Able to pick out crucial factors techniques



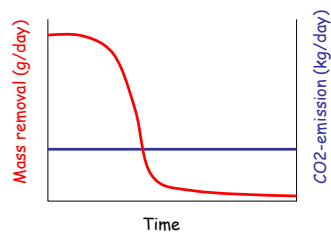
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## Future scope

Reason for tool	Releasing the model in The Netherlands (SKB)
$CO_2$ as parameter	
Scope of tool	Translation into English ( <i>country specifications</i> )
Design of tool	
Experiences	Integration into multi criteria analysis
Future scope	Stop criterion:



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## Future scope

Reason for tool	<b>Ultimate challenge</b>
CO <sub>2</sub> as parameter	
Scope of tool	
Design of tool	'Negative' carbon footprint by sharing facilities for remediation work with (future) neighbourhood needs <i>vice versa</i>
Experiences	
Future scope	Think of renewable energy generator ( <i>wind turbines</i> ) or growing vegetation ( <i>helophyte filter, natural cap</i> )

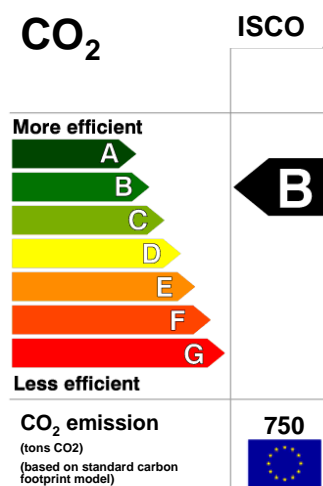


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## Step forward on good housekeeping



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