Livscykelanalys inom efterbehandlingsprojekt

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SNOWMAN

Sustainable maNagement of sOil and groundWater under the pressure of soil pollution and soil contaMinAtioN

Project No. SN-01/20

REJUVENATE

Crop Based Systems for Sustainable Risk Based Land Management for Economically Marginal Degraded Land

r³ environmental technology limited, SGI and FB Engineering AB Sweden, Dechema Germany and Bioclear Netherlands

SGI Statens geotekniska institut *På säker grund för hållbar utveckling*

Rejuvenate

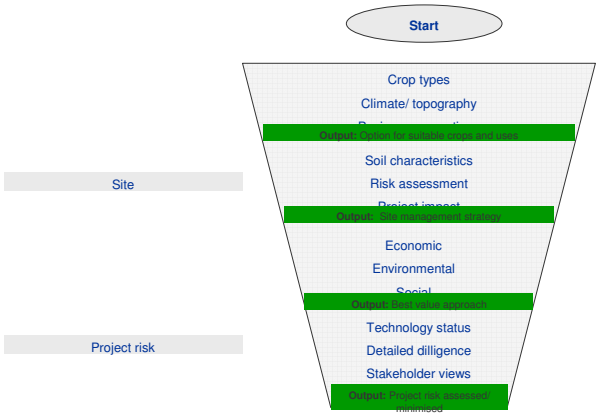
- Möjligheter och barriärer för odling
- av grödor till biobränsle eller an
- produkter (plast, trävaror, fibrer

Figure 1: Salix Vinmalta cultivation at Karlstad oil depot, July 2003.

- Luckor och kunskapsbehov
- Beslutstödsramverk

SGI Statens geotekniska institut *På säker grund för hållbar utveckling*

Filter Diagram



Site specific correlation between main drivers

SGI Statens geotekniska institut *På säker grund för hållbar utveckling*

Värdering av miljöaspekter

- Scenariobaserade fallstudier för odling av biobränsle (*Salix Vinimalis*) :
  - Livscykelanalys
  - Växthusgas/koldioxid avtryck

Val av lämpliga områden

- **Följande aspekter bör beaktas vid val av område:**
- **Läge (skall kunna avyttra produkten)**
- **Areal (tillräckligt stor för att vara ekonomiskt intressant)**
- **Topografi och andra markförhållanden (odlingsbart)**
- **Tidsaspekten (inte i akut behov av sanering vare sig på grund av risk eller exploateringsbehov)**
- **Föroreningsgrad (inte växttoxisk)**
- **Föroreningsdjup (odling av gröda skall bidra till att minska risken)**
- **Potentiella möjliga grödor och dess användning (här salix för markförbättring och/eller biobränsle)**

Fallstudieområden för odling av biobränsle (*Salix Vinimalis*)

- Oljedepå Karlstad

Figure 1: Salix Vinimalis cultivation at Karlstad oil depot, July 2003.

- Före detta industriområde
- Fagervik

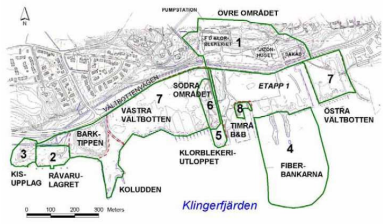
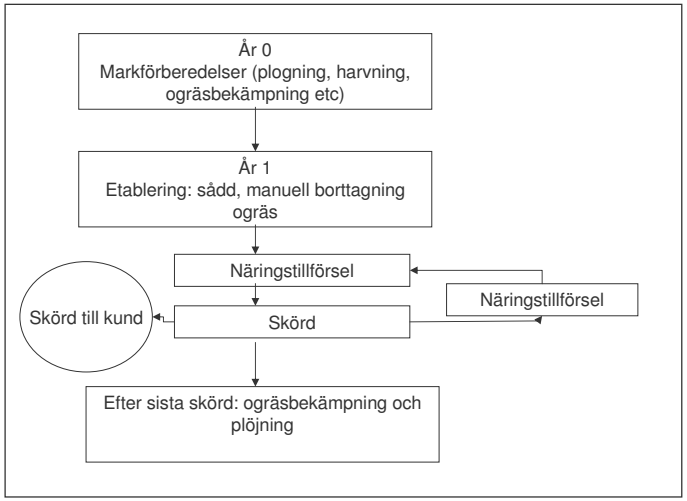
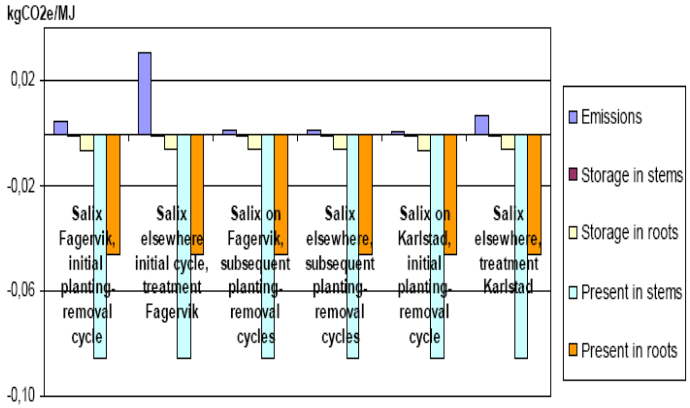


Figure 2: Sublocations from the Fagervik contaminated soil area. From [25].

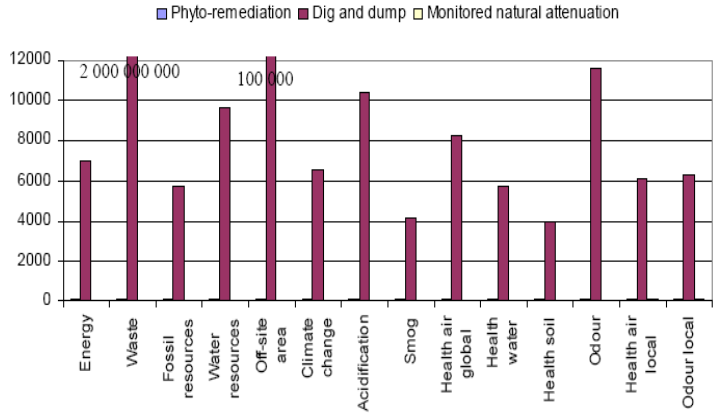
Schematisk beskrivning - normal odling *Salix Vinimalis*



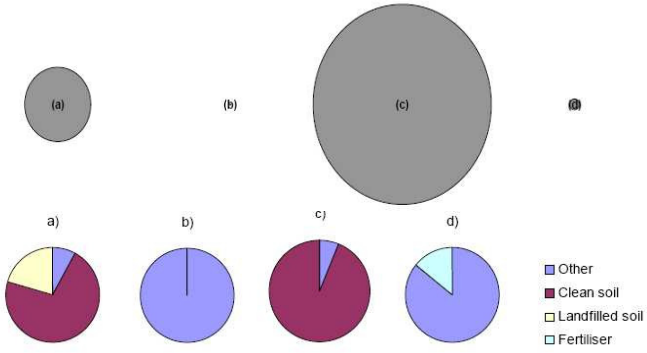
Växthusgas/koldioxidavtryck (carbon foot print)



Livscykelbedömning - Karlstad



Total yta (utanför förorenade området)



a) Karlstad dig-and-dump
b) Karlstad phyto-remediation
c) Fagervik on site ensuring
d) Fagervik salix cultivation for biofuel

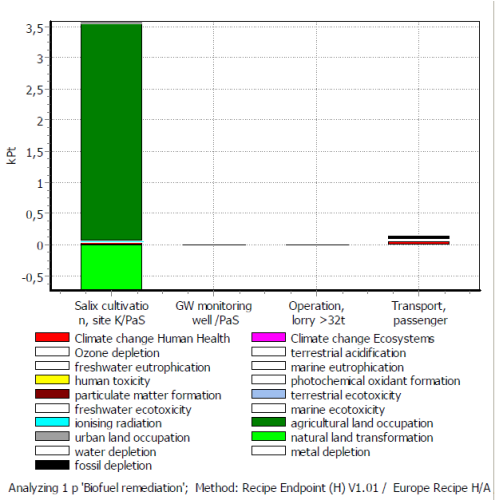


Fig SC 2: Contribution of impact categories to the single score for biofuel remediation, ReCiPe.

Nya resultat (Suer et al., in prep)

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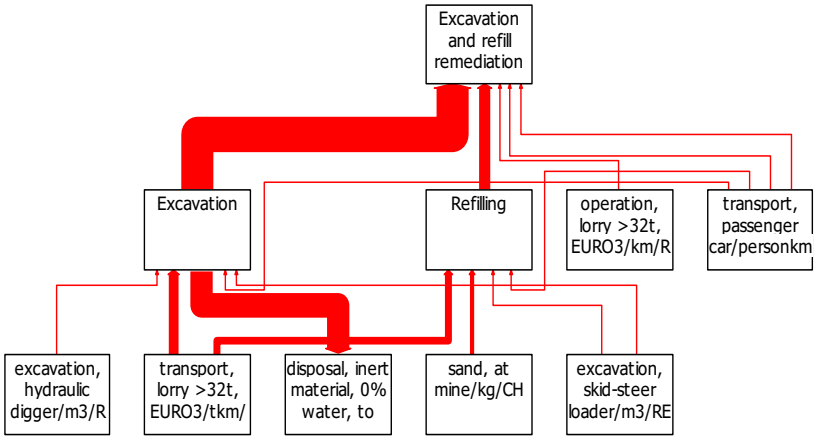


Impact of excavation-and-refill remediation on global warming, EPD.

(Suer et al., in prep)

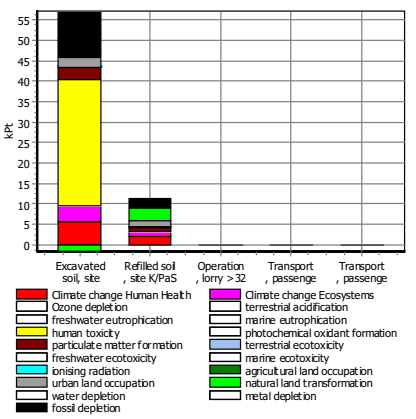
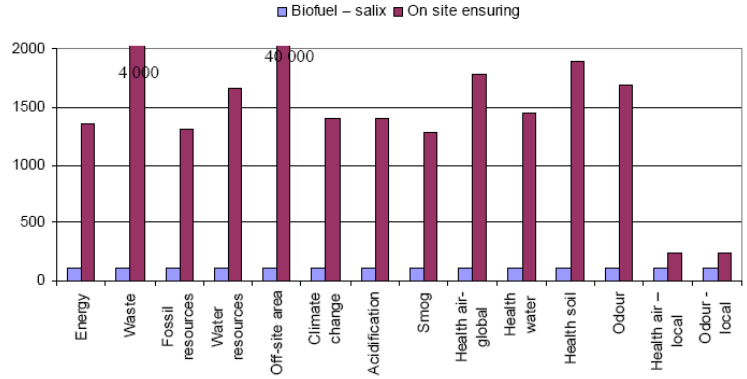


Fig : Contribution of impact categories to the single score for excavation-and-refill remediation, ReCiPe.

Livscykelbedömning - Fagervik



Fytosanering – fördelar och nackdelar

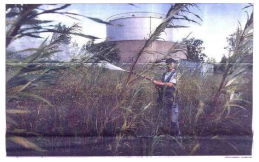


Table appendix 2. Phyto remediation methods, advantages and disadvantages (based on information given in Andersson and Svensson, 2007)

Method	Convenient plants	Advantages	Disadvantages
Phyto extraction: Contaminants are taken up by the plant material and can be extracted when harvested Convenient for Metals (PCB DDE)	Salix, corn (maize) and poplar are in general regarded as good for deep contaminants. May need to mix different species to complement each other. corn > poplar (highly contaminated, pH ~ 4), opposite less contaminated pH > 4 Sareptamustard+EDTA very efficient Cd[1]: Salix very efficient, there are available techniques to Swedish EPAcate Cd from the ash, but most often not used Hg:[2] Salix, wheat, sugar beet, rape, white clover are not efficient Zn, Cu[3]: Salix (optimal pH 4.9)	The biomass from the extraction can be used as a resource (EPA 2000) The amount of biomass to be handled is less than the corresponding amount of soil Combustion of biomass containing metals, produces ash of lower volume than the soil to be handled on landfill	The biomass must be harvested and transported from the site, and metals have to be taken care of Metals can be phyto-toxic for plants It is difficult to move from laboratory to field and remediation (the accumulation probably being less in field than in the laboratory) It can be difficult to find plants with enough translocation of the contaminants
Hyper accumulators[4]	Ni : ~300 species known Co, Cu, Se, Zn ~20 species known	Accumulates high concentrations	Often small plants with short roots: difficult to harvest, do not reach deep contaminants Risk of spreading by lose leaves Risks for animal intake
Phyto "open cast mining"[5]	Zn, Cu, Ni, Co > 20%, in ashes commercially interesting for enrichment, gold > 17 ppm in plant(mass): Serapta mustard+ammonium tio cyanate	Remediation as above and reuse of metals without mining	
Phyto degradation / Phyto transformation: The contaminants are taken up by the plant in where they are degraded or the plant enzymes degrade the contaminants in the root zone. Organic compounds with ability to be taken up by the plant e.g. TNT, MTBE, TCE[6], CN[7]	Plants with large root system and high amount of enzymes able to degrade organic compounds such as poplar 6	Completely independent of microbes and therefore can be used in highly contaminated soils [8]	Potential toxic intermediates (metabolites) Difficult to proof degradation

Förenklad metodik – expertbaserad multikriteria bedömning

Matris 2 – Kategorisering av miljö- och samhällsrelaterade aspekter

	Kategori											
	Hälsa och miljö					**Resurser**			**Sociala och ekonomiska aspekter**			
Åtgärd	Global uppvärmning	Storskalig luftkvalitet	Lokal luftkvalitet	Vattenkvalitet	Markkvalitet	Land resurser	Energi	Råvaror	Välbefinnande/upplevd välfärd	Direkta kostnader	Socioekonomiska aspekter	Flexibilitet
Ingen												

Ny metod (Andersson-Sköld et al., in prep)

Expertbedömning av miljö, hälsa, ekonomiska och sociala aspekter

Table 4: Grading matrix for the biofuel case. The resources, health and environment and costs are based on the life cycle assessment performed in [33]. The remaining aspects are based on the authors experience.

	Health and environment					Resources			Social and economic			
IMPACT CATEGORIES / **Action alternatives**	Climate change- Global warming	Large scale air quality	Local air quality	Water quality	Soil quality	Landscape	Energy	Raw materials	Wellbeing/welfare	Direct costs	Socio-economic aspects	Flexibility
No action	0	0	0	-2	-2	-2	0	0	-2	0	0	4
Salix and combustion	2	0	-1	-1	1	1	2	0	-1	1	-1	1
Salix and gasification	2	0	-1	-1	2	2	2	0	-1	0	-1	3
Fern to DME	1	0	-1	-1	2	1	1	0	0	-1	0	3
Fern , ash extracted	0	0	-1	-1	2	2	1	0	0	-1	0	3
On-site ensuring	-2	-2	-2	-1	0	1	-2	-1	2	-2	2	1

Ny metod (Andersson-Sköld et al., in prep)

Andra expertbaserade metoder t.ex.

Riskvärdering – Kvalitetsmanualen

Grovanalys för riskvärdering av förorenade områden i tidigt skede – GRAF
Utvecklad av Blom et al.

Multikriterieanalys för hållbar efterbehandling– Metodutveckling och exempel på tillämpning
Utvecklad av Rosén et al.

Decision support tool for sustainable management of contaminated sediments in coastal areas
Utvecklad av Svedberg och Holm

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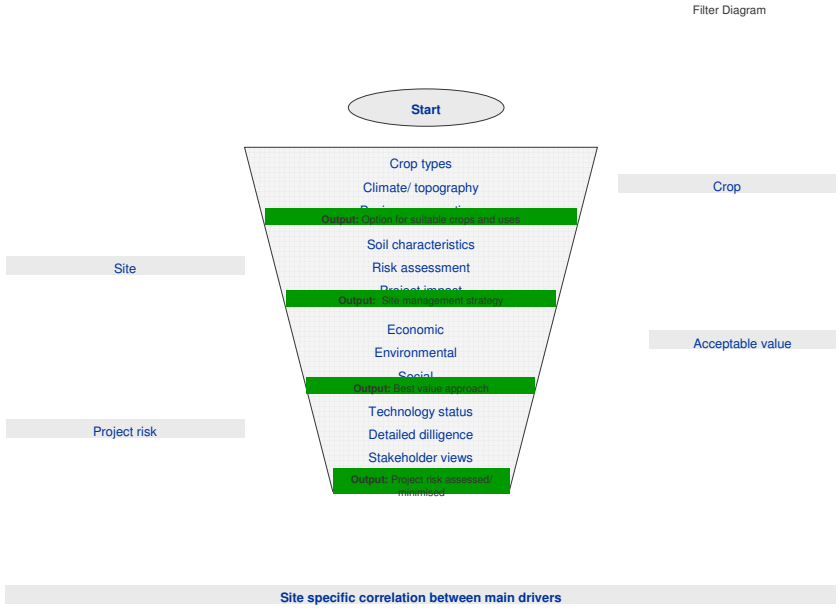

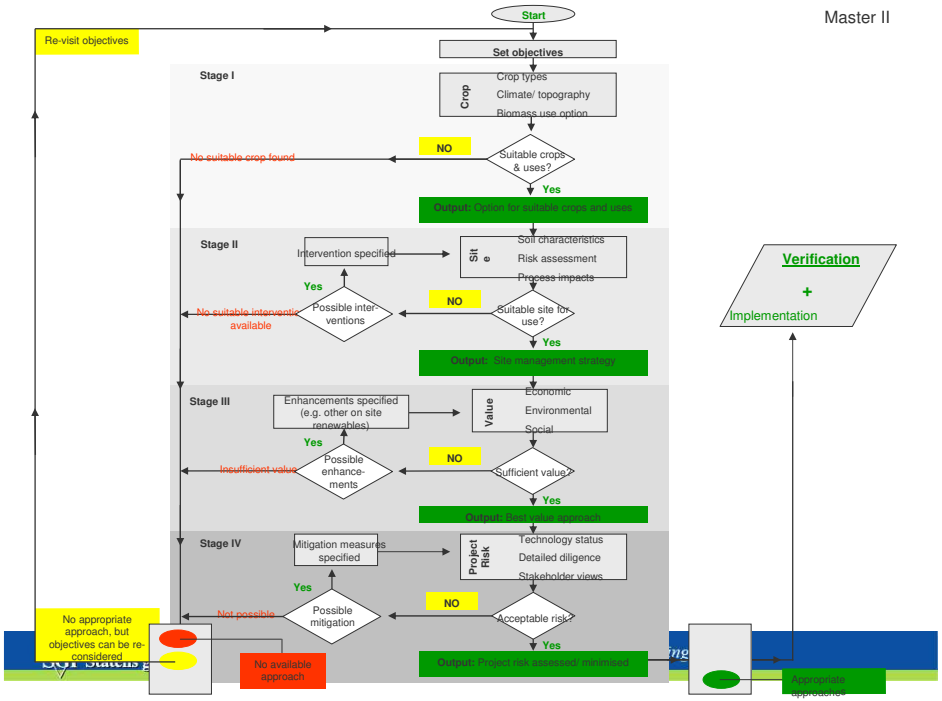

Mer om projektet:

REJUVENASTE Poject No. SN-01/20 Final Research Report (Bardos mfl 2009) http://www.snowman-era.net

www.swegeo.se
SGI Varia 600 LCA, koldioxidavtryck (Suer mfl, 2009) (www.swedgeo.se/upload/Publikationer/Varia/pdf/SGI-V600.pdf)

SGI Varia 599, sammanställning av fytosanering, biobränsle, tillgänglig areal - ”state of the art” Sverige (www.swedgeo.se/upload/Publikationer/Varia/pdf/SGI-V599.pdf)

MKA metod- metodrapport våren 2010

Snowman Rejuvenate II startar 2010 (Sverige, Belgien, Nederländerna och Rumänien samt England och Tyskland)

Finansiering och medverkan Rejuvenate

- FORMAS, DEFRA, Environment Agency, SGI, Naturvårdsverket, SNIFFER, SNOWMAN
- Rejuvenate Team (Paul Bardos, Yvonne Andersson-Sköld, Thomas Track, Marcel Polland, Sytze Keunig)
- FB Engineering AB (Sonja Blom, Alexandra Angelbratt)
- SGI: Pascal Suer, Anja Enell, Ola Wik, Thomas Rihm, Kristina Haglund, Paul Svensson
- Stort tack till alla som vi intervjuat!
- (markägare, energiproducenter, forskare, …)

- TACK!
- Frågor?