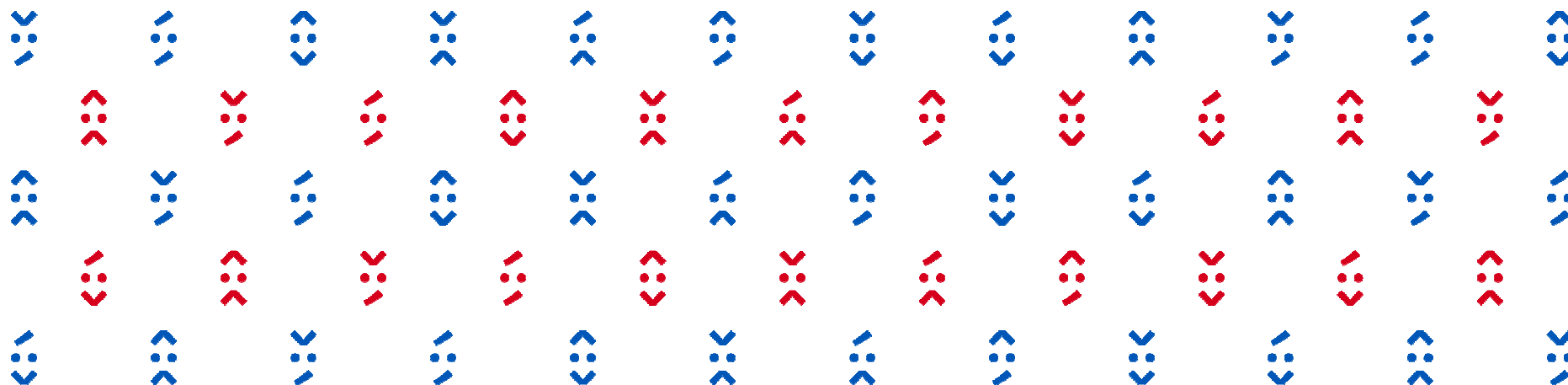




Slovak Presidency of the Council  
of the European Union

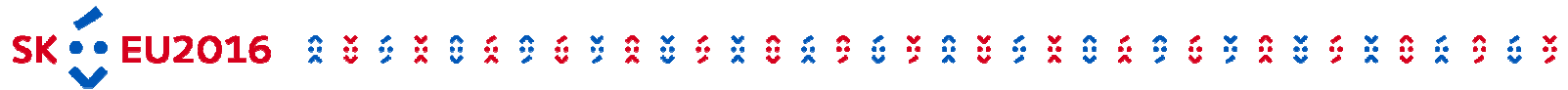


# METHOD OF TREATING CONTAMINATED BROWNFIELDS USING GREEN TECHNOLOGIES

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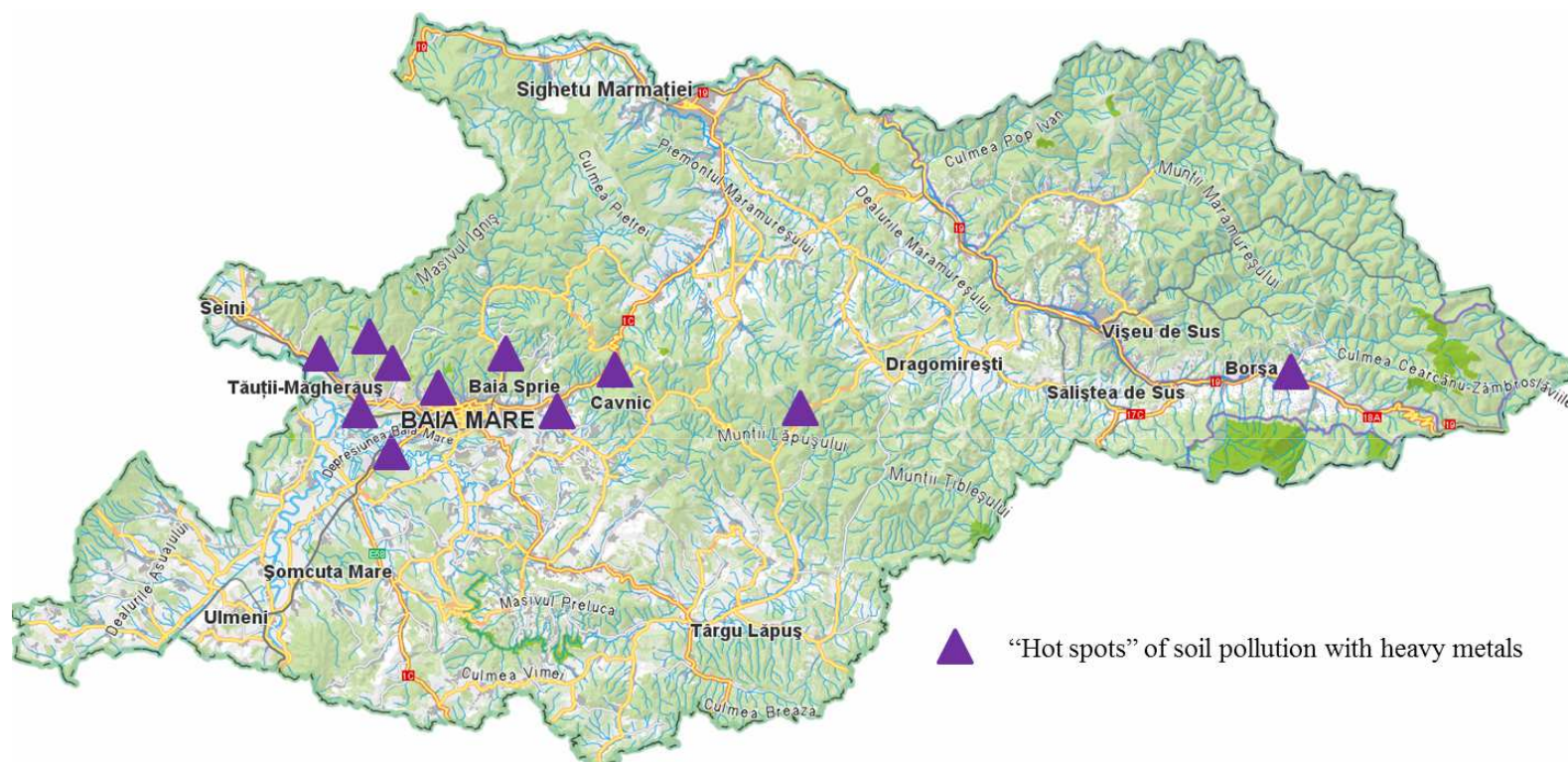
## Main Topics

- Introduction
- Remediation of contaminated sites using green methods
- Case study – Cuprom Baia Mare
- Cuprom area pollution
- Existing situation
- Rehabilitation method – Concept
- Restoring contaminated soil to fertile state
- Ecological restoration of former industrial sites
- Benefits of creating new green spaces and using green technologies
- Conclusions
- Acknowledgements

## Introduction

- National Environmental Protection Agency of Romania has compiled the national inventory in 2014 which recorded a number of **1183 potentially contaminated sites** and **210 contaminated sites**, a total number of 1393 affected sites.
- The economic sectors that have significantly contributed to soil pollution are:
  - Mining and metallurgical industry: **160 potentially contaminated sites**;
  - Petroleum industry: **861 potentially contaminated sites**;
  - Chemical industry: **37 potentially contaminated sites**;
  - Other activities (activities specific to the following industries: energy, electrical engineering and electronics, ceramics, glass, textile and leather, cement, wood, paper, machinery, food, activities specific to land transport, airports, activities specific to agriculture and stockbreeding, military activities, nuclear activities): **125 potentially contaminated sites** (NEPA, 2015).

Industrialization in the Maramureș County from Romania had a major impact on the environment causing **hot spots of soil pollution** (Figure 1) due to the intense exploitation of land resources.



**Fig. 1 Mining areas where soil pollution reaches the highest level in Maramureș County (Boroș et al., 2015)**

## Remediation of contaminated sites using green methods

- Heavy metal contaminated sites are very common in the case of former industrial sites.
- These areas should not be neglected, but converted for the benefit of local communities.
- To address the problem of soil pollution, one green remediation technology that can be applied is phytoremediation.
- Because of the large areas that industrial areas usually occupy, other remedial measures may become too expensive.
- If phytoremediation is combined with biomass production, the entire area can become a source of energy and a successful integration of a former industrial area. In addition, landscape architecture comes with more advantages using the design and redevelopment of the area to increase the value of the studied area.
- This will change public perception and improve the area economically, socially and aesthetically.
- Because applying phytoremediation is a specific process for every site, standard procedures cannot be established, but general guidelines can be taken into consideration for each location and customized at each stage.
- The main objective of remediation projects of any contaminated site is to improve the current situation of each area in order to provide a safe and healthy environment for every citizen.

## Case study – Cuprom Baia Mare

- Former industrial area Cuprom is located in Baia Mare, a city with 100000 citizens in northwest of Romania. The area needs urgent measures of conversion because of its valuable location and because it is a central part of the city that needs to be integrated, not rejected.

Name of owner of the site	Location of contaminated site	Type of polluting activity
CUPROM SA Bucharest Subsidiary Baia Mare	Baia Mare, Romania	Metallurgical industry, copper production
Nature of pollution source	Nature of pollutants	Contaminated area (ha)
Suspension smelting installations of copper concentrates	Heavy metals, sewage, sludge, acidic solutions, petroleum products	58,0



Overview of the case study

Satellite view of the CUPROM area





## Cuprom area pollution

- The area needs urgent measures of conversion because of its valuable location and because it is a central part of the city that needs to be integrated, not rejected.
- Industrialization and urbanization in Baia Mare had negative effects on the environment due to pollution of important areas in the surroundings.
- Nowadays, the city must deal with the historical pollution and there is a lot of investment to be made to decontaminate the soil.
- The Cuprom industrial area is polluted with heavy metals, mostly Cu, Pb, Cd and Zn (Damian et al., 2008).
- Rehabilitation of the entire area is necessary and further studies need to be undertaken regarding the possibilities of remediation.
- The activities of the former Cuprom factory had led to soil contamination, copper having the biggest negative effect on the environment.
- Copper, due to its high concentrations in soil, may enter the food chain and it can affect human and animals' health. Because its concentration reaches the intervention threshold, urgent measures are needed to decontaminate the site and reintegrate it in the urban circuit of Baia Mare.



## Existing situation

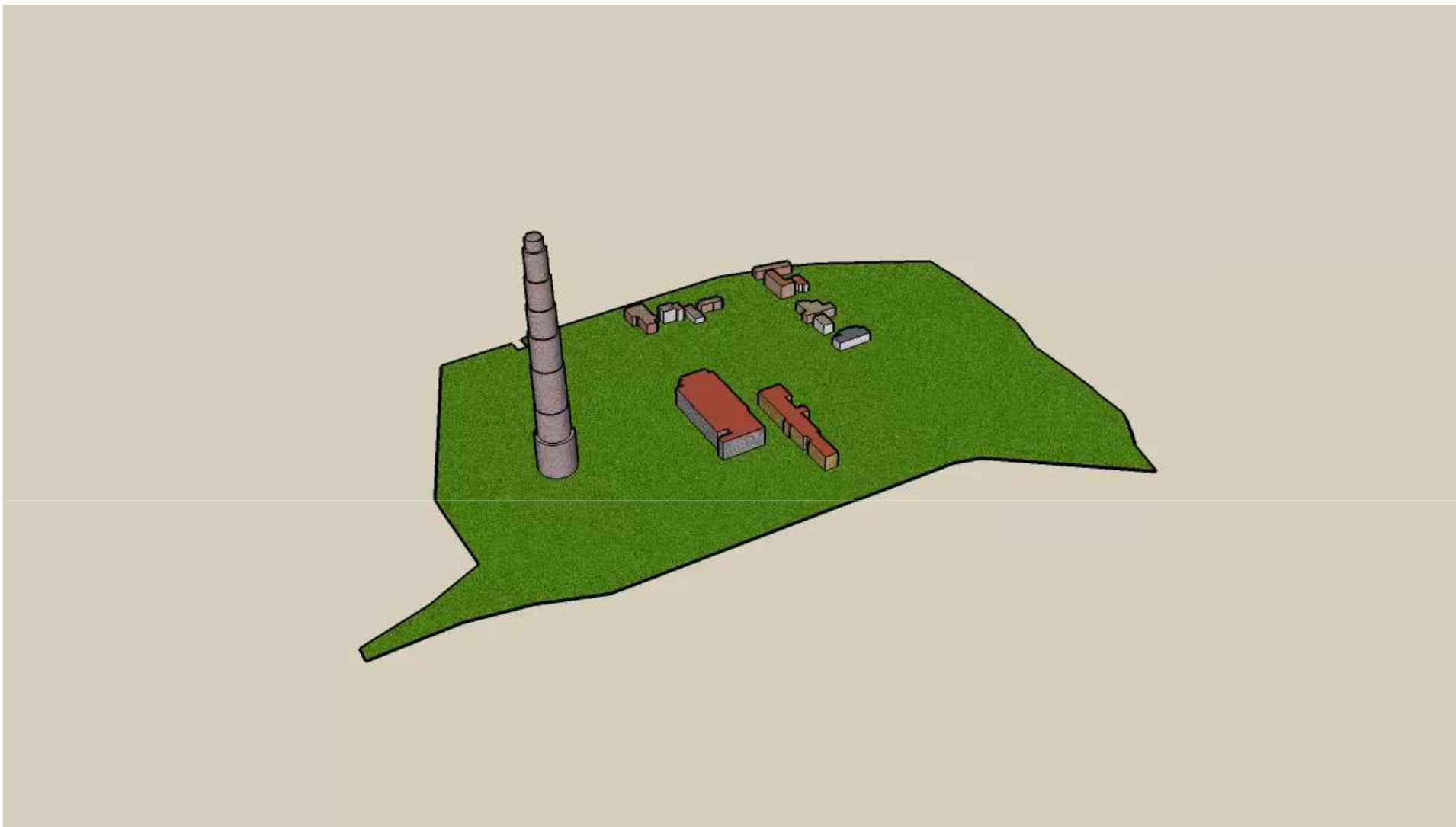
- The current state of the case study can be seen in Figure 2.



**Fig. 2 The actual state of former industrial site Cuprom, located in Baia Mare, Maramureş County of Romania**

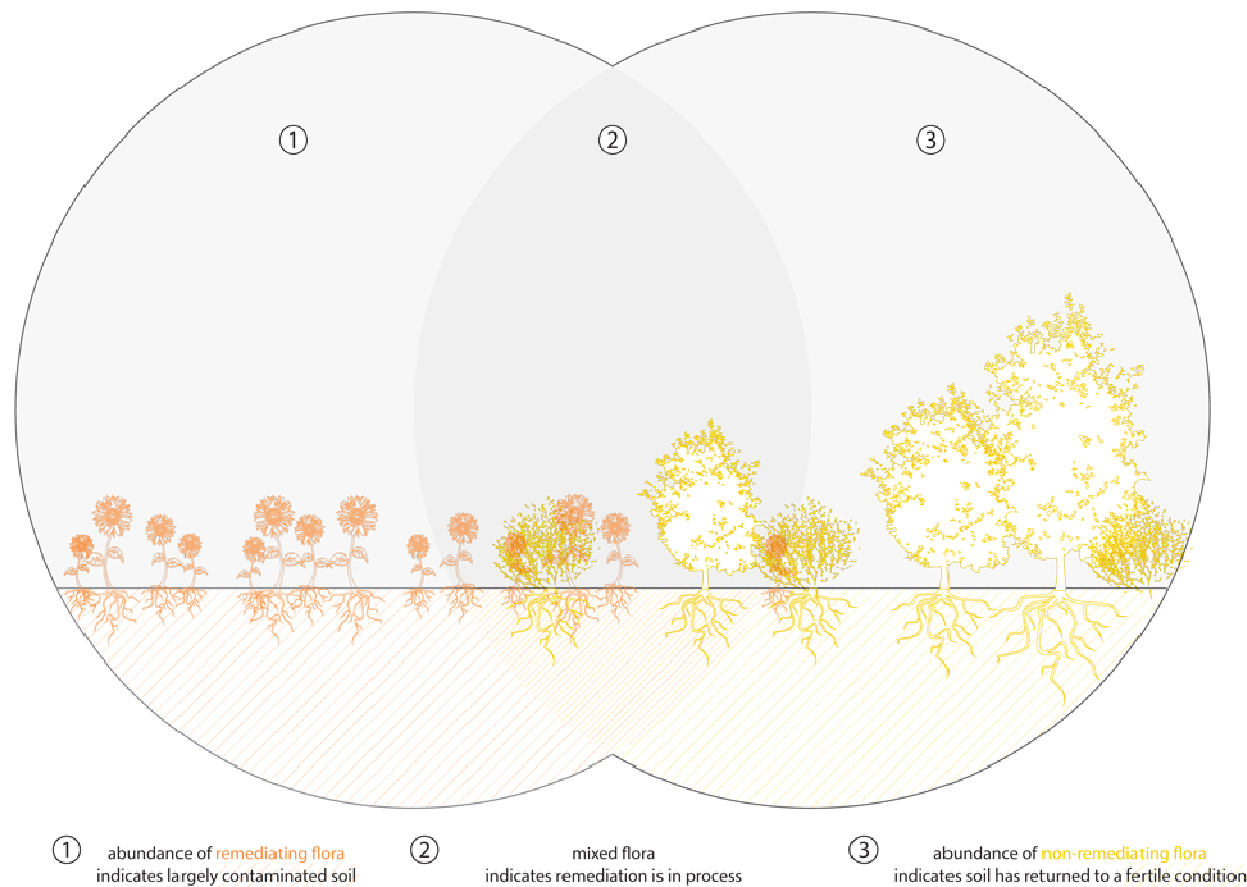
## Rehabilitation method – Concept

- In order to rehabilitate the polluted areas, a method has been developed for greening brownfields using environmentally friendly technologies.
- This requires three phases and combines phytoremediation, energy recovery and landscape architecture for the reintegration of the area in the urban tissue.
- In this way, the plants used in the process receive triple valences: means of soil treatment, ornamental value and also energetic value.
- A model for the rehabilitation of the area using green technologies has been designed to be applied in the Cuprom case study.
- The 3D modelling of the entire area will be presented in the following video.
- Local communities must be involved in every step that is part of the redevelopment.
- The program's success can be associated with public participation and the future use of the area.
- In this way, conflicts and refusal of rehabilitation area because of noise, vibration due to the equipment used, the dust created during the process and other unpleasant activities are eliminated.
- The whole area is easily accepted by citizens and represents a reference area of local identity (Soesilo and Wilson, 1997; ITRC, 2006).



## Restoring contaminated soil to fertile state

- In the case of contaminated brownfields or active industrial sites, where the activities continue to release toxins in the surroundings, efforts of restoring the contaminated soil to a better state should be made in order to create new and stable ecosystems.
- Landscape architecture has a special purpose to transform the space and create stable ecosystems.
- Soil affected by human activities should be treated initially and continuously using phytoremediation.
- Plants that are chosen to clean the site, extract the contaminants from soil while they purify it. In this way, flora develops into a landscape of succession (Figure 3).
- The presence of any kind of vegetation indicates remediation success, while the lack of flora is a major indicator of the need of remedial measures.
- An abundance of new flora means that the new ecosystem can develop (<http://www.draconaei.com/?p=1139>).



**Fig. 3 Phases of restoring contaminated soil to fertile state**  
(<http://www.draconaei.com/?p=1139>)

## Ecological restoration of former industrial sites

- In the process of urban development which aims to create superior living conditions can also be found the reorganization and ecological restoration of polluted and abandoned sites.
- Decontamination of soil and water by using an environmentally friendly technology can be achieved by using phytoremediation and its techniques.
- Ecological restoration of the former industrial sites contributes to improving the environment and biodiversity, but also to energy production through biomass recovery with applications in the following areas:
  - Soil decontamination;
  - Treatment of polluted waters;
  - Biomass production and development of energy crops;
  - Sustainable Development;
  - Energy;
  - Functional reconversion;
  - Landscape Architecture.
- Sustainable solutions (Figure 4) can only be realized if environmental objectives are achieved while the needs of stakeholders are satisfied. Scientific knowledge obtained in research centers can be used to provide ecological solutions to problems that can be widely applied in commerce.

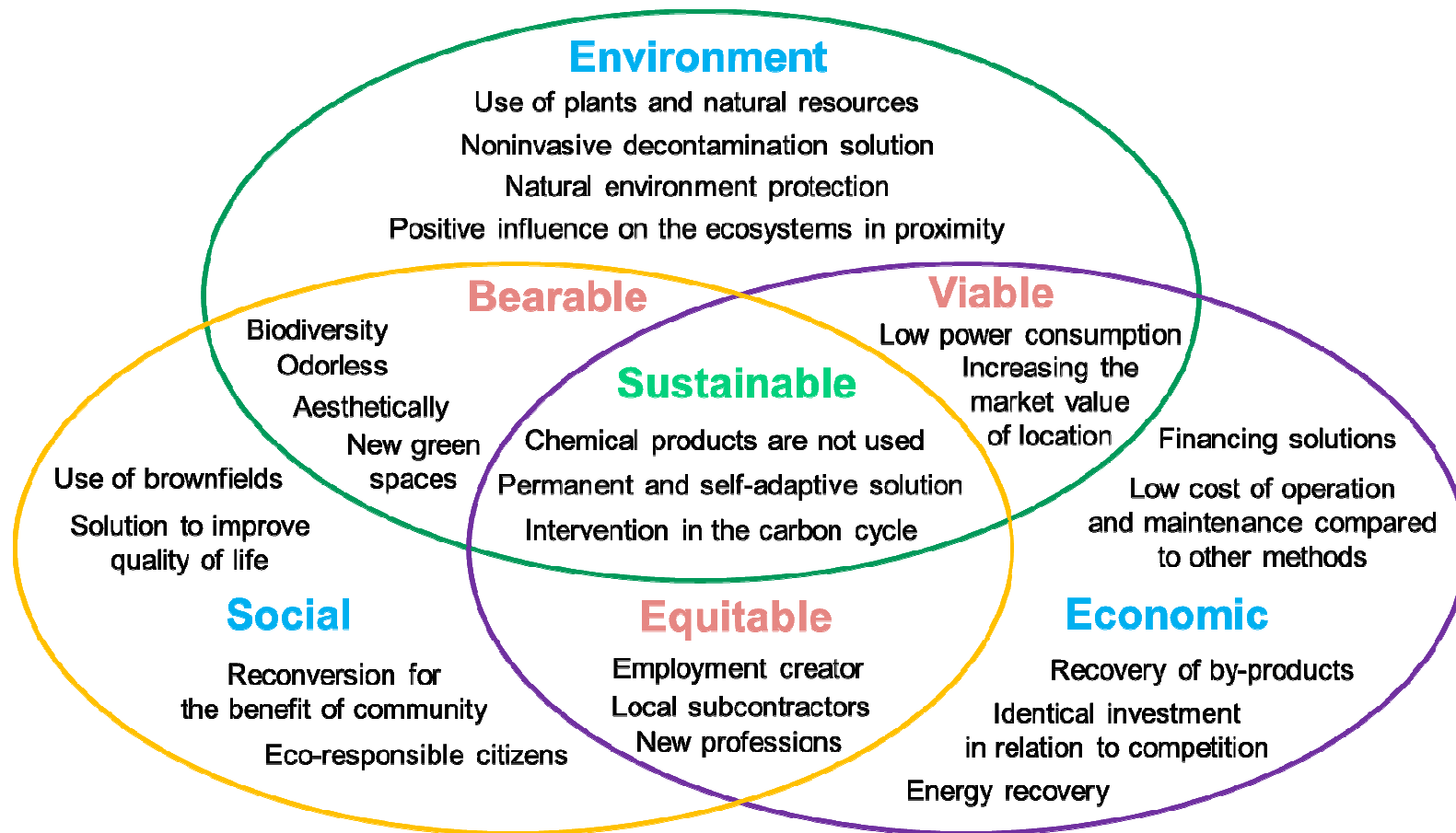


Fig 4. Diagram of objectives regarding sustainable development at environmental, social and economic levels ([http://www.phytorem.com/var/website/storage/images/media/images/schema-developpement-durable/1384-1-fre-FR/schema-developpement-durable\\_page.jpg](http://www.phytorem.com/var/website/storage/images/media/images/schema-developpement-durable/1384-1-fre-FR/schema-developpement-durable_page.jpg))



## Benefits of creating new green spaces and using green technologies

- Creating or expanding ecosystem;
- The involvement and cooperation of the local community;
- Testing and implementing large-scale green remediation technologies;
- Flood control;
- Educational purposes;
- Improving the environment - improving soil, air and groundwater quality;
- Creating new public areas for recreation;
- Generating models for new projects of brownfields rehabilitation;
- Industrial heritage conservation;
- Economic improvement of the area;
- Identifying the sense of local community and social interaction;
- Improving the aesthetics of the area (Sousa, 2013).

## Conclusions

- More or less, all countries are affected by human activities, urbanization and industrial development.
- During these processes, different types of pollutants are spread in soil and lead to environmental deterioration.
- Soil contamination is a major concern worldwide and requires solutions that are eco-friendly and also efficient.
- Decontamination of brownfields is extremely important for the benefit of the environment and local communities.
- An innovative technique to clean these sites is phytoremediation.
- When large areas are required to be treated, phytoremediation is less expensive than the traditional techniques.
- Plants have already been used in various applications to help improve certain contaminated sites.
- A wide variety of sites can be decontaminated using phytoremediation.
- Numerous projects have been developed where it has been applied at large scale or in pilot projects.

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