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Recovery of degraded and transformed ecosystems in coal mining-affected areas

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Deliverable 5.2

Investment and maintenance costs

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Executive summary

In this Deliverable, the investment and maintenance costs for the different scenarios considered for the five case studies (Figaredo Mine in Spain, Janina Mine in Poland, and Ema-Terezie, Most-Ležáky Mine and Chabařovice Mine in the Czech Republic) were specified, collected and calculated.

Special attention was also given to the sunk costs, which are necessary regardless of the scenario selected. These costs were collected to inform the different stakeholders about all the costs involved in the restoration process, not only the ones related to the specific development of foreseen scenarios.

Both investment and maintenance costs are presented in EUR/m^2 and EUR/ha to facilitate their comprehension.

When necessary, the areas involved in the costs (in ha) and the total costs are also presented in the Deliverable, together with the shares of Corinne Land Cover (CLC) classes in each scenario.

1 Introduction

To develop the cost-benefit assessment of the different scenarios, it is necessary to quantify the costs of the alternative actions and the economic value of the ecosystem services provision to determine which options will deliver the most significant benefits concerning their costs.

Deliverable 5.2 was focused on collecting detailed costs of the restoration processes and maintenance costs.

As HUNOSA, TWD and PKÚ are partners of RECOVERY, it was possible to obtain detailed costs of their investment processes and their maintenance costs, as well as reasonably good approximations for the alternative actions that will be proposed, allowing precise cost-benefit calculations.

Again, the monetary values were standardised to common spatial, temporal and currency units, namely Euros per hectare per year, making the information from all the case studies comparable and accessible.

GIG led this task, while the rest of the partners were responsible for collecting cost and maintenance data in their own countries.

2 Investment costs

2.1 Figaredo Mine

Although the first step is always to develop slope stability to achieve a suitable final slope configuration, hydroseeding must be carried out in each mined area. Both slope stability works, covering the slopes with a layer of topsoil and hydroseeding, are sunk costs, as in all cases, they have to be incurred and cannot be recovered, so they were not considered within the investment costs.

A partial restoration took place in 2009 through slope stability works to achieve the final slope configuration (Figure 2-1). On the other hand, Figure 2-2 presents the NW-SE last profile.

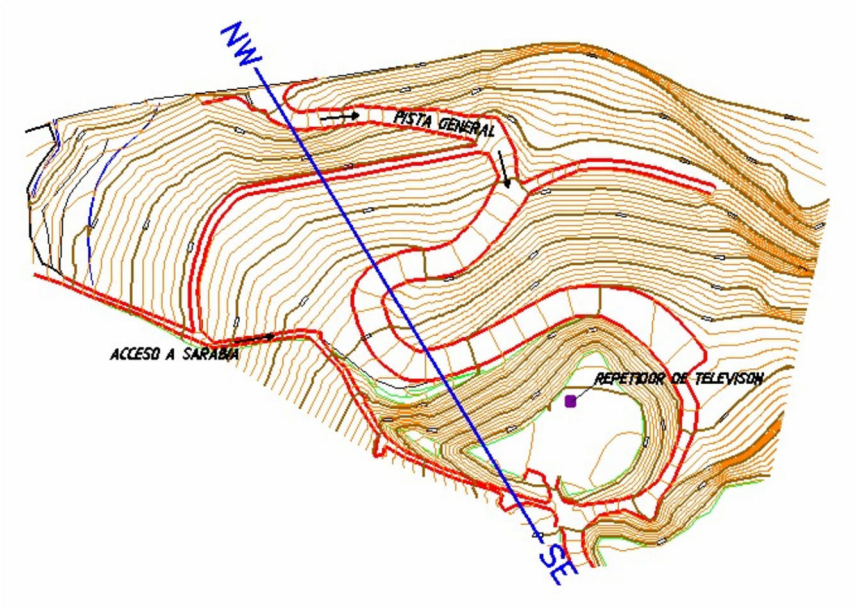


Figure 2-1. Final slope configuration (partial view)

Regarding the hydrology of the restored area, it was considered as the basic principle of action that runoff from the upper part of the dump would be led through the ditches to be made on the service track of the dump itself, towards the outer plaza of the Figaredo Mine, to be finally dumped into the river Turón after being decanted in the rafts located near the pit of the mine, at the bottom of the waste heap.

After this actuation, and to promote herbaceous plants' germination, the entire surface of the restored slopes was covered with a layer of topsoil approximately 25 cm thick. Topsoil came from external stockpiles, spread and refined to prepare the slope's surface for the sowing phase.

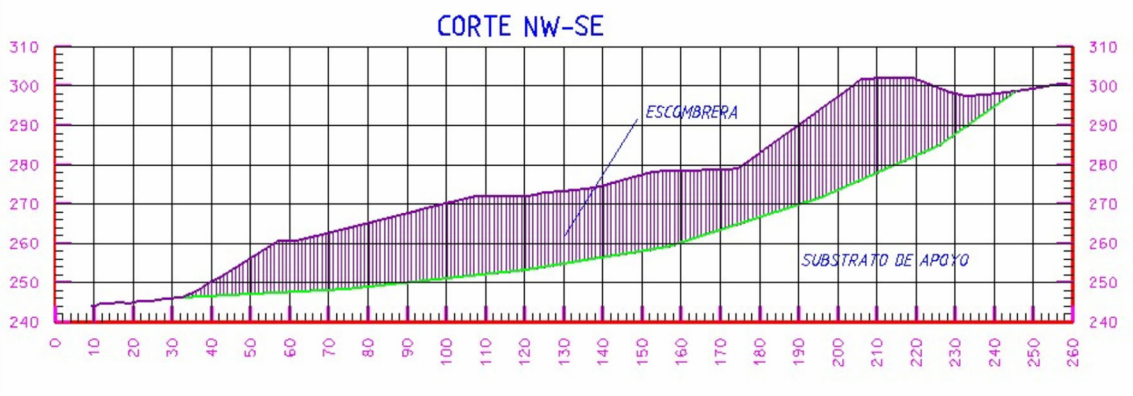


Figure 2-2. NW-SE slope profile

The sowing was carried out with selected herbaceous species, considering the terrain's characteristics (slope, orientation, etc.) and the specific qualities of the different species (rapid germination, vigorous rooting, etc.). The sowing methods were hydroseeding on slopes and manual sowing on platforms with less than a 5º slope.

The components of the sowing and their proportions were: mulch (200 kg/ha), stabiliser (35 kg/ha), seeds (150kg/ha), inorganic fertiliser NPK 8-24-16 (100 kg/ha) and organic amendment of worm humus (240 kg/ha).

The mulch serves as protection for the soil and the seeds that are deposited on it. The stabilisers are organic materials applied in an aqueous solution that, penetrating the ground, contribute to agglomerate particles, improving the overall structure of the soil. Fertilisers and organic amendments are used due to the lack of structure of the soil and the possible loss of nutrients from the applied topsoil layer.

The budget for these sunk costs is presented in Table 2-1.

Table 2-1. Sunk costs at Figaredo Mine

Sunk cost	EUR/m^2	EUR/ha
Land movement	2.78	27 769
Preparatory works	1.93	19 336
Hydroseeding	1.10	11 000

Three were the scenarios proposed in the Figaredo Mine:

1. Fibre production.
2. Food production
3. Broad-leaved forest.

2.1.1 Fibre production

In the case of Figaredo Mine, fibre production refers to pine plantations producing wood as raw material, which is always one of the ecosystem service alternatives traditionally considered in Asturias.

The relevant CICES V5.1 code is 1.1.1.2, and the class is 'Fibres and other materials from cultivated plants, fungi, algae and bacteria for direct use or processing (excluding genetic material)'.

In Asturias, pine plantations have, on average, four trees per 10 m^2, equivalent to 300 trees/ha. After 35 years, a pine plantation will be ready to collect the wood.

Regarding the costs of tree planting (300 trees/ha), according to HUNOSA, they can be estimated at 0.204 €/m^2, equivalent to 2040 €/ha. The planting holes have to be sanitised, and topsoil must be added. Trees should be planted with a tutor and protective netting.

2.1.2 Food production

In this case, food supply refers to cows reared for feed at the Figaredo mine, which can only occur on pasture. However, horses are also reared for feed, which is not as common as cows.

The corresponding CICES V5.1 code is 1.1.3.1, and the class "Animals reared for nutritional purposes".

In Asturias, the cost of buying a cow ready for insemination is about 1,000 euros, plus an insemination cost of 60 euros. The cow will be productive for 14 years, and a similar investment will have to be made by that time.

2.1.3 Broad-leaved forest

Based on several trials developed by HUNOSA, in the case of a broad-leaved forest, an optimal plantation from a forestry perspective was designed for the Figaredo mining area with a density of 250 trees/ha. The species that reconstruct an Asturian broad-leaved forest stand out for their low mortality.

They adapt to all types of terrain, and their soil requirements are much lower than those of other species: *Fraxinus excelsior* (36%), *Betula alba* (36%), *Acer pseudoplatanus* (20%) and *Ilex aquifolium* (8%).

Regarding the costs of planting (250 trees/ha), according to HUNOSA, they can be estimated at 0.170 €/m^2, equivalent to 1700 €/ha. The planting holes have to be

sanitised, and topsoil must be added. Trees should be planted with a tutor and protective netting.

2.2 Janina Mine

The first phase of land reclamation processes on Janina Mine Heaps is a developing layer suitable for vegetation growth. The two types of forming cover layers were designed (multi-layer cover and two-layer cover). A comparison of costs for different methods of the surface of the heap reclamation is shown in Table 2-2.

Table 2-2. Comparison of the costs of materials with the two methods in Janina Mine

Method	Materials	Part costs EUR/2000 m²*	Unit costs EUR/m²
Multi-layer cover	Soil substitute for the surface layer	1 891	4.43
	Dolomite aggregate 0-31,5 mm	2 132	
	Sealing material	133	
	Geotextile	1 164	
	Dolomite aggregate 31,5-63 mm	4 586	
Two-layer cover	Soil substitute for the surface layer and mixed with wastes	2836	1.27

* The costs incurred during study plot formation.

Formulation of surface cover requires:

a) the use of machinery that allows the weighing of individual components, e.g. hauliers with load weight measurement, loaders with load weight measurement in the bucket;
b) the use of machines and methods that thoroughly mix the soil substitutes produced.
c) The use of heavy machines to cover the heap surface of prepared soil substrate.

The work cost for the two-layer cover formulation is estimated at 2.3 €/m^2. In the case of a multi-layer cover, the price is 11.9 €/m^2.

The multi-layer technology is recommended on the part of the heap where an intensive process of rainwater infiltration occurs, and the risk of acid drainage appearance is high. This cover layer formation will be used at the flat top of the heap, where sports and leisure facilities will be introduced. The two-layer cover is cheaper but ensures better conditions for deeper rooting plants. This reclamation method will be used for transitional woodland-shrub, natural grassland and green urban areas.

The second phase of the reclamation process is the formation of vegetation cover. The cost for vegetation development is estimated based on costs incurred during study plot formation.

To ensure high landscape values, shrub vegetation will be introduced in the lower part of the slopes of the dump and places exposed to water erosion. The top of the dump and the upper parts of the slopes will be covered with low vegetation of high species diversity and extensive participation of flowering herbaceous plants.

Wetland vegetation will be initiated on the banks of the reservoirs. The cost of meadow development, including the mixture of herb and grass seeds acquisition and sowing, is approximately 1.68 €/m^2.

The plantation of three plant communities for post-mining rehabilitation shrubs contain, i.e., Wild privet (*Ligustrum vulgare*), Sea-buckthorn (*Hippophae rhamnoides*), Common hawthorn (*Crataegus monogyna*) is estimated on 4.7 €/m^2 The wetland vegetation have to be planted on 10 % area of water bodies to create semi-natural water ecosystems. The Common reed (*Phragmites australis*) proposed for wetland vegetation is estimated at 2.9 €/m^2.

Three scenarios were proposed in Janina Mine:

1. Increasing the natural and recreational potential.
2. Increasing the economic potential.
3. Increasing the natural, recreational and economic potential.

2.2.1 Increasing the natural and recreational potential

Considering the recommendations for future planning and development of the post-mining landscape, five types of land rehabilitation and ecosystem restoration actions will be proposed for the scenario I, as follows:

- Space for green urban areas (low vegetation of dry-loving grasslands and flower meadows),
- Transitional woodland-shrubs,
- Natural grasslands,
- Area for sports and leisure facilities (walking and cycling paths, sports fields and outdoor gyms),
- Water bodies.

The share of particular land use types in the scenario I is presented in Table 2-3.

Table 2-3. Share of CLC types on the scenario I in Janina Mine

Land Use	Area (ha)
Green urban areas	5.52
Transitional woodland-shrub	19.96
Natural grassland	19.97
Sports and leisure facilities	7.34
Water bodies	15.72

The cost of installing the small infrastructure in sport and leisure facilities and green urban areas was estimated based on the cost incurred in a similar project[1,2] .

The total investment cost of scenario I for land rehabilitation of Janina Mine Waste Heap in Libiąż is presented in Table 2-4.

Table 2-4. The investment cost of scenario I in Janina Mine

Item	EUR/m^2	EUR/ha	Area (ha)	Cost (EUR)
Green urban areas			**5.52**	**652 740**
Two-layer cover (on 90% of the area)	3.57	35 700	4.97	177 358
Meadow vegetation development (on 90% of the area)	1.68	16 800	4.97	83 462
Small infrastructure (hiking paths made of natural materials, bird observation posts, piers, benches) (on 10% of the area)	71	710 000	0.55	391 920
Transitional woodland-shrub			**19.96**	**2 123 744**
Two-layer cover (on 100% of the area)	3.57	35 700	19.96	712 572
Shrubs planting (on 100% of the area)	4.7	47 000	19.96	938 120
Installation of fencing again animals	0.69	6 900	19.96	137 724
Meadow vegetation development (anti-erosion functions) (on 100% of the area)	1.68	16 800	19.96	335 328
Natural grassland			**19.97**	**1 048 425**
Two-layer cover	3.57	35 700	19.97	712 929
Meadow vegetation development	1.68	16 800	19.97	335 496

[1] Organizing tourist traffic within the Żabie Doły Nature and Landscape Complex to protect nature and biodiversity and adapt the area for educational and recreational purposes. Regional Operational Program of the Silesian Voivodeship for 2014-2020.
[2] Heap revitalization in Ruda Śląska. Implementation of Sustainable Land Use in Integrated Environmental Management of Functional Urban Areas (LUMAT). INTERREG Centar Europe.

Sport and leisure facilities (7,34)			**7.34**	**3 963 453**
Multi-layer cover (on 60% of the area)	16.33	163 300	4.40	719 173
Setting up a lawn (on 60% of the area)	3	30 000	4.40	132 120
Small infrastructure (walking and cycling paths, sports fields and outdoor gyms) (in 40% of the area)	106	1 060 000	2.936	3 112 160
Water bodies			**15.72**	**101 708**
Two-layer cover (on 10% of water bodies area)	3.57	35 700	1.57	56 120
Wetland vegetation (on 10% of water bodies area)	2.9	29 000	1.57	45 588
TOTAL COST				**7 890 071**

2.2.2 Increasing the economic potential

In scenario II, increasing the economic potential, the two-layer methods will cover the Janina heaps' unsealed surface around the photovoltaic farm and industrial area. To ensure anti-erosion function, low vegetation must be developed in this type of area. To increase biodiversity, the meadow vegetation is recommended for this function.

The scenario focused on increasing its economic potential due to location advantages, the possibility of using large areas with solar energy plants (photovoltaic panels), and the available capacity for locating mining waste. The share of particular land use types in scenario III is presented in Table 2-5.

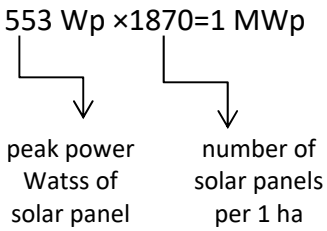
Table 2-5. Share of CLC types on scenario II in Janina Mine

Land Use	Area (ha)
Dump sites (current mining settlement)	11.99
Construction sites (photovoltaic farm)	50.1
Industrial or commercial units	6.42

The cost of making roads was considered for preparing the waste heap's north part for industrial purposes. The use of the coal mining settlement for depositing mining waste doesn't need additional investment costs.

The price of photovoltaic panel installation (PV) includes the cost of materials and performance cost. The prices were estimated based on Polish market offers.

The indirect cost included site supervisor, geodetic services, site facilities and access to media, site security and site insurance, and was estimated as 558 511 € per 1MW, which correspond to 1 ha, as follows:



The total investment cost of solar energy panels installation is presented in Table 2-6.

Table 2-6. The investment cost of the photovoltaic farm in Janina Mine

Item	EUR/m^2	EUR/ha
Project documentation	2.13	21 277
Solar modules	31.91	319 149
Solar inverters	5.32	53 191
Support constructions	8.51	85 106
DC and AC cable lines and protection components	4.26	42 553
Transformer station,	10.64	106 383
Medium voltage connection	1.06	10 638
Fencing	2.13	21 277
Indirect cost	2.13	21 277
Total cost	**68.09**	**680 851**

The total cost of PV installation located in 50.1 ha was calculated at more than 34 M€.

The total investment cost of scenario II for land rehabilitation of Janina Mine Waste Heap in Libiąż was presented in Table 2-7.

Table 2-7. The investment cost of scenario II in Janina Mine

Item	EUR/m^2	EUR/ha	Area (ha)	Cost (EUR)
Construction sites			**50.1**	**34 786 434**
Solar energy panels	68.09	680 900	50.1	34 113 090
Meadow vegetation development on 80% of the area (anti-erosion functions)	1.68	16 800	40.08	673 344
Industrial or commercial units			**6.42**	**436 817**
Road construction (on 15% of the area)	42	420 000	0.963	404 460
Meadow vegetation development on 30% of the area (anti-erosion functions)	1.68	16 800	1.926	32 357
TOTAL COST				**35 223 251**

2.2.3 Increasing the natural, recreational and economic potential

Scenario III assumes the development of a multifunctional area constituting the basis for establishing a business, producing energy from renewable sources and spending free time in areas with specific natural values. Scenario III considers transforming the sedimentation tank into a semi-natural water reservoir and creating spaces occupied by low vegetation and shrubs.

Considering the recommendations for future planning and development of the post-mining landscape, four types of land rehabilitation and ecosystem restoration actions will be proposed for scenario III, as follows:

- space for green urban areas (low vegetation of dry-loving grasslands and flower meadows),
- transitional woodland-shrubs,
- natural grasslands,
- area for sports and leisure facilities (walking and cycling paths, sports fields and outdoor gyms),
- construction sites (photovoltaics farm),
- industrial or commercial units,
- water body.

The share of particular land use types in scenario III is presented in Table 2-8.

Table 2-8. Share of CLC types on scenario III in Janina Mine

Land Use	Area (ha)	Share (%)
Green urban areas	7.36	10.7
Industrial or commercial units	4.45	6.5
Transitional woodland-shrub	18.97	27.7
Construction sites	4.55	6.6
Sports and leisure facilities	6.14	9.0
Natural grasslands	17.09	24.9
Water bodies	9.96	14.5

The individual investment cost for Scenario III includes the costs described in Scenario I and Scenario II.

The total investment cost of scenario III for land rehabilitation of Janina Mine Waste Heap in Libiąż is presented in Table 2-9.

Table 2-9. The investment cost of scenario III in Janina Mine

Item	EUR/m²	EUR/ha	Area (ha)	Cost (EUR)
Green urban aas			**7.36**	**870 320**
Two-layer cover (on 90% of the area)	3.57	35 700	6.624	236 477
Meadow vegetation development (on 90% of the area)	1.68	16 800	6.624	111 283
Small infrastructure on 10% of the area (hiking paths made of natural materials. bird observation posts. piers. benches)	71	710 000	0.736	522 560
Transitional woodland-shrub			**18.97**	**1 731 582**
Two-layer cover (on 100% of the area)	3.57	35 700	18.97	677 229
Shrubs planting (on 100% of the area)	4.7	47 000	18.97	891 590
Installation of fencing again animals	0.69	6 900	18.97	130 893
Meadow vegetation development on 100% of the area (anti-erosion functions)	1.68	1 680	18.97	31 870
Natural grassland			**17.09**	**89 723**
Two-layer cover	3.57	3 570	17.09	61 011
Meadow vegetation development	1.68	1 680	17.09	28 711
Sports and leisure facilities			**6.14**	**3 315 477**
Multi-layer cover (on 60% of the area)	16.33	163 300	3.684	601 597
Setting up a lawn (on 60% of the area)	3	30 000	3.684	110 520
Small infrastructure in 40% of the area (walking and cycling paths. sports fields, and outdoor gyms)	106	1 060 000	2.456	2 603 360
Water bodies			**9.96**	**64 441**
Two-layer cover (on 10% of water bodies area)	3.57	35 700	0.996	35 557
Wetland vegetation (on 10% of water bodies area)	2.9	29 000	0.996	28 884
Construction sites			**4.55**	**3 159 247**
Solar energy plants	68.09	680 900	4.55	3 098 095
Meadow vegetation development on 80% of the area (anti-erosion functions)	1.68	16 800	3.64	61 152
Industrial or commercial units			**4.45**	**302 778**
Road construction (on 15% of the area)	42	420 000	0.6675	280 350
Meadow vegetation development on 30% of the area (anti-erosion functions)	1.68	16 800	1.335	22 428
TOTAL COST				**9 533 568**

2.3 Ema-Terezie Mine dump complex

Three restoration scenarios were suggested for the case of the Ema–Terezie Mine dump complex in the Czech Republic:

1. **Recreation**: Scenario I is created by merging Wild Animal and "without any interventions" scenarios, which assumed only slight interventions in the area with a preference for extensive use. The mine dump complex is almost in the centre of the city of Ostrava, so it has significant potential for recreation and leisure–time activities. Excepting these recreational activities, support of ecological functions is also suitable and desirable for using the area (establishment and management of flower meadows, support of entomofauna, etc.). Part of Ema – Terezie area is characterised by non-interventional urban wilderness (CLC: Mixed Forest 313) and by a Broad-leaved Forest as typical native forest in the region: mainly *Betula pendula*, *Quercus robur*, *Sorbus aucuparia*, *Acer platanoides*, *Acer pseudoplatanus* and *Carpinus betulus* in terms of predominant ecological function. Nevertheless, this can be considered a mixed scenario of a Broad-leaved Forest and a physical recreation area. People can walk and enjoy nature observation around the area without developing specific infrastructure for physical recreation.

2. **Combination of land use intentions**: Scenario II is a combination of the using area for Housing (CLC: Discontinuous urban fabric 112), HorseTrails (CLC: Sport and leisure facilities 142), Pastures (CLC: Pastures 231) and ForestPark (CLC: Mixed Forest 313). It assumes ecological, hippo - tourist and partly extensive agricultural use of the area. Horse breeding and riding are suitable on account of the riding school which currently exists here.

3. **Forest Park**: Scenario III is characterised in terms of the principal recreational function when a forest park (CLC: Mixed Forest 313) with equipment for outdoor sports and furniture is built on the territory of the mine dump complex. Support for ecological functions is not as crucial as in Scenario I.

The previous scenarios are associated with the following CLC classes:

1. **Mixed Forest (313)**: for all scenarios.
2. **Pastures (231)**: for the Combination of land use intentions and Forest Park scenario.
3. **Sport and leisure facilities (142)**: for the Combination of land use intentions.
4. **Discontinuous urban fabric (112)**: for the Combination of land use intentions.

The first step of restoration for all the scenarios that were considered for the Ema-Terezie Mine dump complex is to:

1. Eliminate illegal waste sites - for all scenarios.
2. Cut down invasive (*Robinia pseudoacacia*, by selective pruning in the forest) and non-native trees (*Picea pungens*, widespread, the poor health status of the stand), remove invasive stands of *Reynoutria spp*.
3. Removal of reinforced concrete structures in the former Trojice coke plant and the locations of the planned family development.
4. Flatten out the terrain at black-illegal metal mining in the area of the Trojice coke plant.
5. Modification of the Burňa stream surroundings - preparation of the terrain for revitalisation measures, covering of tailings with earth, reinforcement of the banks of the pool - (creation of habitat for frogs *Bombina bombina* and *Bombina variegata*).

The first step of restoration for Scenario I is the preparation of land for planting native trees in the place of removed *Picea pungens* (Broad-leaved Forest with the species composition of *Quercus robur*, *Tilia cordata*, *Acer platanoides*, *Acer pseudoplatanus*, *Sorbus aucuparia*, *Carpinus betulus* and shrubs – *Viburnum opulus*, *Crataegus monogyna*, *Cornus mas*, *Swida sanquinea*). In the part of the urban wilderness, the non-interventional area. The territory will be equipped with park furniture - benches and trash cans.

The first step of restoration for Scenario II is as follows. Housing: Land preparation for family development, including infrastructure. Horse Trails: Construction of paths for horses (consolidated gravel 2 m wide). Pastures: Land preparation for the restoration of permanent grassland. Sowing seeds of herbs and grasses from native plant species, sowing manually. Forest Park: plantations of target domestic tree species. Construction of pedestrian paths. Construction of a fitness path. The territory will be equipped with park furniture - benches and trash cans.

2.3.1 Recreation

In this section, the following items are counted in the individual Scenario I:

- Clearing (illegal waste sites).
- Construction of unpaved trails.
- The revitalisation of the water course.
- Random logging.
- Removal of removed trees.
- Planting deciduous trees (300 trees/ha).
- Planting deciduous trees (75 trees/ha).
- Installation of park furniture.

Some investments are planned to apply only to the same part of the solved area. The area has 62.91 ha (Table 2-10) and should be used as a natural mixed forest.

Table 2-10. Change rules for CLC land use classes in Scenario I in Ema-Terezie

Lad use	CLC 2006	Scenario I
Dumpsites	62.91 ha	0 ha
Mixed forest	0 ha	62.91 ha

Table 2-11 presents the costs of items per hectare and the percentage of the extent to which the item should be applied. For example, there is an area of 1.34 ha where the trees will be substituted with more native species, which are typical for this region. Logging and planting deciduous trees (300 trees/ha) are planned only inside this small area. The proportion of this area to the whole area of the suggested Mixed Forest is 1.34 / 62.91 = 0.0213 (2.13%). Similarly, the construction of unpaved trails. There was a proposed building of up to 5200 m trails with a 2 m width. It means 5200 x 2=10 400 m^2 (1.04 ha) of trails. The proportion of this area to the whole area of the suggested Mixed Forest is 1.04 / 62.91 = 0.0165 (1.65%). All items, which should be applied to smaller specific areas, were evaluated in proportion to the whole area of the suggested Mixed Forest.

Table 2-11. Costs and proportions of areas in Scenario I in Ema-Terezie

Item	EUR/m^2	EUR/ha	% of CLC: 313
Clearing (illegal waste sites)	0.00318	31.80	100%
Construction of unpaved trails	48.00	480 000.00	1.65%
The revitalisation of the water course	40.00	400 000.00	0.09%
Random logging	10.00	100 000.00	2.13%
Removal of removed trees	0.0806	806.00	3.35%
Planting deciduous trees (300 trees/ha)	0.0360	360.00	2.13%
Planting deciduous trees (75 trees/ha)	0.0090	90.00	97.87%
Installation of park furniture	0.0217	217.00	100%

Some costs were directly available per area in price lists. For example, costs for Planting trees and Revitalisation of the watercourse are in the price list of the Nature Conservation Agency of the Czech Republic in Czech crowns per m^2. It was easily recalculated to EUR/ha (1 Euro = 25 CZK). Similarly, costs for the construction of unpaved trails.

Other costs were set differently. Pricing of installation of park furniture was derived from the price of a single bench and trash can, the number of its pieces and the cost of the installation work. The evaluated total price for park furniture installation was divided into all hectares afterwards (62.91 ha). In the case of Clearing (illegal waste sites), the volume (the number of crucks with specific capacity) was estimated. The price for its

removal was found in the list of the company operating waste dumps in Hrusov. The price for removal of all estimated waste was divided by all area (62.91 ha).

The mean cost representing each hectare homogeneously (concerning applying some items to smaller specific areas) was calculated. Proportions of the area where the item should be used (4th column in Table 2-11) were multiplied by the cost per hectare (3rd column in Table 2-11). For example, Planting trees (75 trees/ha) should be applied 97.87%, and its cost is 90 EUR/ha. Via multiplying 90 x 0.9798, we have cost 88.08 EUR/ha, representing the mean cost for each hectare of CLC Mixed Forest (regardless of the item). The cost of investments for some parts of the area is spread to all area. The multiples are available in the second column in Table 2-12. Finally, all mean costs for all items were summed.

Table 2-12. Mean cost for Mixed Forest (CLC: 313) in Scenario I in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Construction of unpaved trails	7920.00
The revitalisation of the water course	360.00
Random logging	2130.00
Removal of removed trees	27.00
Planting deciduous trees (300 trees/ha)	7.66
Planting deciduous trees (75 trees/ha)	88.08
Installation of park furniture	217.00
Total EUR (CLC: 313)	**10 781.55**

2.3.2 Combination of land use intentions

In the Combination of land use intentions (Mixed forest (313), Pastures (231), Sport and leisure facilities (142), and Discontinuous urban fabric (112)), there is no need to undergo decontamination, as the part of the area for housing is not contaminated.

In this section, the following items are counted in individual Scenario II:

- Clearing (illegal waste sites).
- Demolition of reinforced concrete structures.
- Landscaping with heavy mechanisation.
- Construction of unpaved trails.
- The revitalisation of the water course.
- Random logging.
- Removal of removed trees.
- Removal of invasive plants.
- Planting deciduous trees (300 trees/ha).
- Planting deciduous trees (75 trees/ha).

- Restoration of the grass cover, including the price of the seed.
- Grass cutting, including removal.
- Installation of park furniture.
- Fitness trail (set of 8 elements).
- Construction of family houses.

The change rules for CLC land use classes for Scenario II are presented in Table 2-13.

Table 2-13. Change rules for CLC land use classes in Scenario II in Ema-Terezie

Lad use	CLC 2006	Scenario II
Dumpsites	62.91	0
Discontinuous urban fabric	0	6.49
Sports and leisure facilities	0	15.85
Pastures	0	0.67
Mixed forest	0	39.9

Costs per hectare and proportions of areas where the item should be applied in Table 2-14 were evaluated in the same way as it was done for Scenario I. But there is more than one suggested land use category in this case. Between these categories, the solved whole solved area (62.91 ha) was divided (areas in Table 2-13).

The proportions of areas in Table 2-14 are related to the area of specific suggested land use category (one of the categories: 112, 142, 231 or 313). For example, the area with 1.34 ha (of place where the trees will be substituted with more native species) in Scenario I was related to the area 62.91ha. It is related to 39.9 ha in this case (1,34 / 39,9 = 0,0335 > 3,35% of Mixed Forest). This specific area is part of the Mixed Forest, and a smaller area was delimited for Mixed Forest in Scenario II. Proportions for Scenario I are not the same as for Scenario II (table 2-14). But the method for its evaluation is the same.

Some costs must be estimated there. In the case of the Demolition of reinforced concrete structures, the cost was derived from the estimated volume of material, which must be removed, and the price for removing 1 m^3 was found. So, the cost per hectare was calculated similarly to the cost of Clearing (illegal waste site), described in Investments of Scenario I.

Because of the four suggested land use categories for the solved area, the investment for each indicated category was calculated separately. Some selected items from Table 2-14 will be applied to the specific category (for example, all items used for CLC: 112, according to the 4th column in Table 2-14).

Table 2-14. Costs and proportions in Scenario II, where items should be applied in Ema-Terezie

Item	EUR/m²	EUR/ha	Applied on % of the designed CLC
Clearing (illegal waste sites)	0.00318	32	100% for all CLC
Demolition of reinforced concrete structures	0.057225	572	100% for CLC:112 3% for CLC:142
Landscaping with heavy mechanisation	28.00	280 000	100% for CLC:112 10% for CLC:142 10% for CLC:313
Construction of unpaved trails	48.00	480 000	1,65% for CLC:142 1,65% for CLC:313
The revitalisation of the water course	40.00	400 000	0,14% of CLC:313
Random logging	10.00	100 000	3,35% of CLC:313
Removal of removed trees	0.080597	805.97	3,35% of CLC:313
Removal invasive plants	0.12	1200	100% for CLC:112 100% for CLC:231
Planting deciduous trees (300 trees/ha)	0.0360	360	3,35% for CLC:313
Planting deciduous trees (75 trees/ha)	0.0090	90	100% for CLC:142 96,65% for CLC:313
Restoration of the grass cover (including the price of the seed)	0.0280	280	100% for CLC:231 10% for CLC:142
Installation of park furniture	0.0241	241	100% for CLC:142 100% for CLC:313
Fitness trail (set of 8 elements)	1.8000	18 000	6,31% for CLC:142
Construction of family houses	120.0000	1 200 000	100% for CLC:112

Table 2-15 presents the mean costs for Discontinuous urban fabric (CLC: 112). The items from Table 2-14 were copied into Table 2-15, with processing the same as for Scenario I (multiplying proportions and costs; summing all multiplies).

Table 2-15. Mean costs for Discontinuous urban fabric (CLC: 112) in Scenario II in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Demolition of reinforced concrete structures	572.25
Landscaping with heavy mechanisation	280 000
Removal of invasive plants (higher than 1m)	1200
Construction of family houses	1 200 000
Total EUR (CLC: 112)	**1 481 804**

Table 2-16 presents the mean costs for Sports and leisure facilities (CLC: 142).

Table 2-16. Mean costs for Sport and leisure facilities (CLC: 142) in Scenario II in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Demolition of reinforced concrete structures	17.16
Landscaping with heavy mechanisation	280.00
Construction of unpaved trails	7920
Restoration of the grass cover, including the price of the seed	28.00
Fitness trail (set of 8 elements)	1135.80
Planting deciduous trees (75 trees/ha)	90.00
Installation of park furniture	241.05
Total EUR (CLC: 142)	**9743.81**

Table 2-17 presents the mean costs for Pastures (CLC: 231).

Table 2-17. Mean costs for Pastures (CLC: 231) in Scenario II in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Removal invasive plants	1200.00
Restoration of the grass cover (including the price of the seed)	280.00
Total EUR (CLC: 231)	**1511.80**

Table 2-18 presents the mean costs for Mixed forests (CLC: 313) in Scenario II.

Table 2-18. Mean costs for Mixed forests (CLC: 313) in Scenario II in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Landscaping with heavy mechanisation	28 000
Construction of unpaved trails	7920
The revitalisation of the water course	560
Random logging	3350
Clearing (illegal waste sites)	27.00
Planting deciduous trees (300 trees/ha)	12.06
Planting deciduous trees (75 trees/ha)	86.98
Installation of park furniture	241.05
Total EUR (CLC=313)	**40 229**

2.3.3 Forest park

In this section, the following items are counted in individual Scenario III:

- Clearing (illegal waste sites).
- Demolition of reinforced concrete structures.
- Construction of unpaved trails.
- The revitalisation of the water course.
- Random logging.
- Removal of removed trees.
- Planting deciduous trees (300 trees/ha).
- Planting deciduous trees (75 trees/ha).
- Installation of park furniture.
- Fitness trail (set of 8 elements).

Table 2-19 shows the change rules for CLC land use classes in Scenario III.

Table 2-19. Change rules for CLC land use classes in Scenario III in Ema-Terezie

Lad use	CLC 2006	Scenario III
Dumpsites	62.91	0
Pastures	0	0.67
Mixed forest	0	62.24

Table 2-20 presents the costs and proportions of areas in Scenario III.

Table 2-20. Costs and proportions in Scenario III, where items should be applied in Ema-Terezie

Item	EUR/m2	EUR/ha	Applied on % of the designed CLC
Clearing (illegal waste sites)	0.00318	31.80	100% for all CLC
Demolition of concrete structures	0.057225	572.25	3% for CLC:313
Landscaping with heavy mechanisation	28.00	280 000	10% for CLC:313
Construction of unpaved trails	48.00	480 000	1,65% for CLC:231 1,65% for CLC:313
The revitalisation of the water course	40.00	400 000	0,09% of CLC:313
Random logging	10.00	100 000	2,15% of CLC:313
Removal of removed trees	0.080597	805.97	2,15% of CLC:313
Removal of air raids above 1m	0.12	1200	100% for CLC:231
Planting deciduous trees (300 trees/ha)	0.0360	360.00	2,15% for CLC:313
Planting deciduous trees (75 trees/ha)	0.0090	90.00	97,85% for CLC:313
Restoration of the grass cover, including the price of the seed	0.0280	280.00	100% for CLC:231
Installation of park furniture	0.0217	216.18	100% for CLC:231 100% for CLC:313
Fitness trail (set of 8 elements)	1.8000	18 000	1,61% for CLC:313

Table 2-21 shows the mean cost for Pastures (CLC: 231) in Scenario III.

Table 2-21. Mean cost for Pastures (CLC: 231) in Scenario III in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Construction of unpaved trails	7920
Removal of air raids above 1m	1200
Restoration of the grass cover, including the price of the seed	280,00
Installation of park furniture	216,18
Total EUR (CLC: 231)	**9908**

Finally, Table 2-22 shows the mean cost for Mixed Forest (CLC: 313) in Scenario III.

Table 2-22. Mean cost for Mixed Forest (CLC: 313) in Scenario III in Ema-Terezie

Item	EUR/ha
Clearing (illegal waste sites)	31.80
Demolition of reinforced concrete structures	17.16
Landscaping with heavy mechanisation	28 000
Construction of unpaved trails	7920
The revitalisation of the water course	360
Random logging	2150
Removal of removed trees	17.32
Planting deciduous trees (300 trees/ha)	7.74
Planting deciduous trees (75 trees/ha)	88.06
Installation of park furniture	216.18
Fitness trail (set of 8 elements)	289.80
Total EUR (CLC: 313)	**390 988**

2.4 Most-Ležáky Mine

Based on an expert assessment of a variant solution for the use of the residual pit after brown coal mining, the wet variant, or a variant using hydraulic reclamation of most of the area affected by previous coal mining, which successfully went through the Environmental Impact Assessment (EIA) process.

Since 1999, the location has been securing and dealing with the costs of smoothing the consequences of mining activity without available financial resources. Based on the request of the private mining company MUS a.s., the Government of the Czech Republic approved the incorporation of the remaining assets of the subsidiary MUS a.s. - Důl Kohinoor a.s. under PKÚ, s.p., which took effect on 1 January 2004.

Since 2004, PKÚ, s.p. has acted as a legal entity based on an open tender, ensuring all material and administrative steps leading to a comprehensive process of smoothing the consequences of mining activity. These steps were divided according to the reason and temporal continuity of the preparation of hydric reclamation into the following stages:

1. Remediation of landslides of the final slopes of the residual pit of the Ležáky-Most quarry.
2. Sealing the bottom of the residual pit.
3. Construction of a water inlet.
4. Construction of anti-abrasive elements, drainage, and purpose-built roads.
5. Technical reclamation above the horizon of the residual pit's permanent flooding line.
6. Biological reclamation above the horizon of the residual pit's permanent flooding line.

Items 1, 2, 4 and 5 were classified in the category of technical reclamation. The process of biological recultivation (6) is a continuous process that the legal predecessor took over. Therefore, its implementation has been taking place by PKÚ, s. p. since January 2004, as before, it was a private company that developed the reclamation.

As a part of the remediation of landslides, approximately 5.8 M EUR (1 Euro = 25 CZK) was spent preparing hydraulic reclamation. The bottom's mineral sealing is a vital part of the hydraulic reclamation preparation, and this is a process preventing the subsequent leakage of accumulated water into the surrounding mining environment.

In the case of the residual pit of the Ležáky-Most quarry, it was necessary to prevent the leakage of accumulated water into the unexcavated parts of the stratum and the heterogeneous elements of the internal dumping area. The cost of bottom sealing amounted to 23.6 M EUR.

To secure the water supply from the Ohře River, mainly due to the distance of approx. 5 km and the technical infrastructure was spent approximately 3.92 M EUR. Lake Most was filling from 24/10/2008 – 30/9/2014, plus cyclic compensation for evaporation.

The construction of anti-abrasive elements of the shoreline required an investment of approximately 3.6 M EUR, and the construction of roads increased the investment by another 0.8 M EUR and drainage by another 0.36 M EUR.

The remaining amount, up to a total of 0.06 M EUR, was spent on technical and biological recultivation of the area above the operational level of Lake Most.

For the case of Most-Ležáky Mine (Czechia), three restoration scenarios are foreseen:

1. **Recreation**: Physical recreation and free time activity with biking and hiking trails.
2. **Combination of scenarios**: Physical recreation and free time activity, biking and hiking trails, transitional woodland shrubs, and natural grassland.
3. **Nature**: transitional woodland shrub and natural grassland - leaving the area for more natural development without significant interventions in the landscape.

The previous scenarios are associated with the following CLC classes:

1. **Recreation**: Transitional woodland-shrub (324).
2. **Combination of scenarios**: Non-Irrigated arable land (211), Broad-leaved forest (311), Natural grassland (321), Transitional woodland-shrub (324), Sparsely vegetated areas (333), Water bodies (512).
3. **Nature scenario**: Non-Irrigated arable land (211), Broad-leaved forest (311), Natural grassland (321), Transitional woodland-shrub (324), Sparsely vegetated areas (333), Water bodies (512).

2.4.1 Recreation

Several studies and proposals for the future use of the area around Lake Most have already been prepared. For the RECOVERY project, materials from Bohemia Arch spol. s r.o. were used.

Considering that the location of Lake Most is currently being developed for recreational, sports and adventure activities, it is planned to build a lookout on the northern slope of Lake Most, including parking spaces. The realisation of the Lookout at this place is suitable from the point of view of elevation and the shape of the terrain. The parking place is designed between the main road and the bike path so that there is no collision between car traffic and bicycle traffic. The Lookout will be visited by tourists but also by cyclists who can take a rest here.

The lookout project includes several parts, with an area of 193 ha corresponding to this scenario:

- **Shelter**: A light steel structure covered with wood-decorated panels, with a countertop that will serve as a resting place or shelter in bad weather. The shelter will contain several tables, benches, and trash cans. From the rear access side, the shelter is fully open. From the front side is a panoramic opening with a view of the lake.

- **Observation deck**: The light steel structure of the footbridge made of steel profiles is located near the shelter and extends 20 m into the sloping terrain towards the lake. The end of the footbridge is equipped with an information

board with a panoramic drawing of significant points in the landscape. The footbridge structure is subtle and airy, with a horizontal division that underlines the perception of the view.

- **Landscaping**: The path (park) in front of the shelter is shaped like a drop, referring to the nearby water body, with a green island in the middle. Trees will be planted - an alley of Norway maple (*Acer platanoides*). Birch trees will be planted in the centre of the circular island, and the tree trunk diameter will be a minimum of 80 mm. Permanent tall grasses will be planted in a partial section of the Lookout.

The investment costs are presented in Table 2-23.

Table 2-23. Investment costs for Recreation in Most-Ležáky Mine

Item	EUR/m^2	Total costs (EUR)
Lookout	88.80	301 268

2.4.2 Combination of scenarios

All investments from scenarios I and III will be implemented as part of the initial costs. The combination of scenarios will aim to create an environment close to nature. However, visitors' needs from the wider area will be considered primary recreation and leisure activities.

From Scenario I, Lookout on the north side of Lake Most will be realised with all its parts: a shelter, an observation deck, and a set of objects with additional landscaping.

From scenario III, an approach that respects the landscape's natural appearance to the maximum extent with a minimum of human interventions will be taken over. Large areas of land will be available for wild fauna and flora, providing them with enough living space.

Life in the lake was already ensured as part of hydraulic reclamation by stocking fish in the form of non-predatory and predatory fish, which fulfil both ecological and aesthetic functions (reduction of algae, cyanobacteria, prevention of fish overpopulation, cleanliness, and quality of water, etc.). Therefore, no expenses are considered.

An area of 1166 ha corresponds to this scenario.

Table 2-24 presents the investment costs for this scenario.

Table 2-24. Investment costs for a Combination of scenarios in Most-Ležáky Mine

Item	EUR/m^2	Total costs (EUR)
Viewpoint	88.80	301 268

2.4.3 Nature

The Scenario nature is based on the fact that human interventions in this location will be limited to an absolute minimum. The initial state is the remediation of the slopes and surrounding areas, the subsequent agricultural and forestry reclamation of the dumps and the controlled hydraulic reclamation of the residual pit, resulting in the creation of Lake Most.

In the early days, when the area's future development had not yet been decided, asphalt roads (cycle paths, inline tracks, and essential service roads) were built around the perimeter and immediate surroundings of the lake. Although artificial routes are available for visitors to do sports (bicycle, inline skates) and hiking, nature will prevail in the future. There are extensive integrated areas with nature conservation potential. If parts of the territory are left to natural development, the occurrence of rare species and biodiversity will increase. In the first seasons, wild birds chose the northern part of the lake, which is more isolated from the hustle and bustle of the city (Most), as their favourite wintering place.

The essence of this scenario is to leave most of the territory to natural development without significant human interventions. These are mainly the northern and northeastern areas around the lake, which have been identified with the most considerable nature conservation potential, so that wild animals and plants can thrive here. Life in the lake was already ensured as part of hydraulic reclamation by stocking fish in the form of non-predatory and predatory fish, which fulfil both ecological and aesthetic functions (reduction of algae, cyanobacteria, prevention of fish overpopulation, cleanliness, and quality of water, etc.). Therefore, no expenses are considered. For the above reason, fishing will be prohibited in the lake, which the operator will systematically check.

An area of 1166 ha corresponds to this scenario, and no investment costs will arise under Scenario III.

2.5 Chabařovice Mine

The issue of remediation and reclamation was the same as at the Ležáky-Most residual pit and included in particular:

- Remediation of landslides and cracks above the horizon of the operational level of Lake Milada.
- Technical and biological reclamation above Lake Milada is operating level horizon.
- Sealing the bottom and the exposed pillar of the coal seam.
- Construction of drainage ditches and purpose-built roads.

In 1991, the Resolution of the Government of the Czech Republic decided to stop the Chabařovice quarry, and since that year, it has been gradually reduced and liquidated. The attenuation itself began in 1994. During the gradual reduction of coal mining and overburden, the question of how to dispose of the residual pit arose. Two variants were offered: wet and dry. Based on the negotiations of the Association for the Revitalisation of the Territory, the wet option was agreed upon, which brought with it the possibility of building the missing area for the residents of Ústí nad Labem and the surrounding municipalities in an area devastated by long-term mining activity. In April 1997, all mining, processing, and sales of coal ended.

The entire revitalised area is divided into individual areas separately designed in connection with the surrounding area. Reclamation works include necessary landscaping, construction of drainage ditches, access roads and biological reclamation. The forestry reclamation method is used for its hydrological, anti-erosion, stabilisation, sanitation, climatic and recreational functions. As part of afforestation, regional bio corridors and local bio centres are planted locally.

The lake and the built water reservoirs represent hydric reclamation, i.e., impregnation with water. Heating of the residual pit was provided by the state-owned company Palivový kombinát Ústí. It was started on 15 June 2001 with the former fire water primary Js 300 from the Kateřina reservoir. The main source of water supply from the Kateřina reservoir to the lake was the reconstructed Zalužanský stream flowing through the Zalužanská reservoir and further through the inflow channel to the lake.

In 2004, work began on anti-abrasive measures and shore fortification. In places intended for swimming and sunbathing, the fortifications were modified to allow access to the lake. In August 2008, the lake filling system was changed. In the section from the Zalužanská reservoir, a new channel leading to the Anti-eutrophication reservoir was built, and water from this reservoir overflowed through ditch "N" into the lake. The permitted maximum for releasing water from the Kateřinská reservoir was 700 l/s. Another source of inflow was the overflow well on the north side of the lake, and with the rising sea level, it was rebuilt in places with a higher altitude. In November 2008, construction work was completed on overflow well No. 9 (overflow well No. 6 was cancelled and dismantled). After the groundwater level rose to the required height, filling from this source was started.

Among the critical problems of the revitalisation of the area is achieving the optimal final quality of the lake's water, which can be used for ecological purposes and bathing. Water quality is regularly monitored by taking samples at so-called monitoring points. As part of bioregulatory protection, species of predatory fish were planted in the lake: Common pike - *Esox lucius*, Large catfish - *Silurus glanis*.

The area of interest of the Chabařovice quarry falls into the Bílina river basin. With the "Transfer of water from the lake Chabařovice to the Bílina river" construction, excess water from the lake was channelled through a connecting pipe into an open ditch, which opens into the Bílina river. Two reservoirs were established to protect the Chabařovice quarry from inflows of surface water from the west: Modlany and Kateřina.

The filling of Lake Milada was completed on 8 August 2010 by reaching the final state of the operational level at an elevation of 145.7 m above sea level. When this level was reached, the lake's water volume was 35.601 million $m^{3,}$ and the area was 252.2 ha.

Table 2-25 presents the costs and other figures of the reclamation plan.

Table 2-25. Reclamation plan costs and figures in Chabařovice Mine

Item*	Unit	Before 31.12.1992	After 1.1.1993	Total
Coal mining	M t	54.8	11.5	66.3
Completed reclamation	ha	-	1284.6	1284.6
Reclamation in progress	ha	108.6	-108.6	-
Total reclamation	ha	108.6	1176.0	1284.6
Costs of normal reclamations	M EUR	2.96	26.7	29.66
Cost of reclamation of the residual pit	M EUR	-	87.84	87.84
Water reclamation costs	M EUR	-	68.48	68.48
Capitalisation of water pumping costs	M EUR	-	45.36	45.36
Total cost of reclamation	**M EUR**	**2.96**	**228.38**	**231.34**

* Comprehensive rehabilitation and reclamation plan. Change used: 1 Euro = 25 CZK.

For the case of Chabařovice Mine, three restoration scenarios were foreseen:

1. **Recreation**: Physical recreation, free time activity and leisure areas.
2. **Combination of scenarios**: Physical recreation, free time activity, leisure areas and biking trails.
3. **Sport**: Physical recreation and free time and biking trails.

The previous scenarios are associated with the following CLC classes:

1. **Recreation**: Pastures (231), Broad-leaved forest (311), Transitional woodland-shrub (324).
2. **Combination of scenarios**: Pastures (231), Broad-leaved forest (311), Transitional woodland-shrub (324).
3. **Sport**: Pastures (231).

2.5.1 Recreation

Due to the lack of a framework concept for the further development of the interest area of Lake Milada, it was decided in 2019 to announce an open International Landscape, Urban, and Architectural Design Competition to solve the interest area of Lake Milada. The Swedish landscape studio Mandaworks AB announced the competition's winner on 15 June 2021. The resulting conceptual study will become a critical governing document for the further development of the area and a possible basis for amending the spatial planning documentation of the Ústí nad Labem Region and the affected municipalities. The proposed solution of Scenario I and partly of Scenario II is based on material from Mandaworks AB.

After the reclamation, Lake Milada was intended as a recreational area, but insufficient facilities did not make it possible to fulfil the landscape's recreational potential. Therefore, it is desirable to create conditions for different types of recreation and to provide destinations for visitors of other age groups, interests, and backgrounds.

Recreation in the area should not be only active - focused on sports and leisure, but also of a passive nature, which takes full advantage of the beauty of the surrounding environment and offers places for quiet and intimate observation of the landscape. For these needs, new interventions in the landscape will be created that can serve as rest areas, lookout towers or shelters in bad weather.

The objects co-create public spaces in the landscape, and their location encourages exploring the entire landscape and its yet-undiscovered nooks and crannies. The objects provide views, facilities, new activities, and a quiet and peaceful place to relax in the landscape.

The proposed initiation objects are simple landscape buildings based on the same structural and material design. The dominant element of the buildings is their roof, with dimensions 5 x 4 m, which provides shelter and comfortable facilities in times of bad weather or shade on summer days. The buildings are further complemented by equipment that offers various uses - benches, grills, information boards, etc. The main supporting structure of the roof is steel columns with square profiles anchored to concrete foundations or blocks. The roof comprises a wooden frame structure and internal and external cladding. The treatment of the outer surface of the roof with a

burnt wood finish (Shou-sugi-ban) creates natural protection against climatic conditions. The plan is to build 23 objects on a total area of 900.28 ha.

Table 2-26 presents the investment costs.

Table 2-26. Investment costs for Recreation in Chabařovice Mine

Item	Quantity	Total m^2	Costs EUR
Small shelter with sitting and information	7	140	429 185
Picnic shelter	4	80	294 298
Elevated shelter	6	120	539 546
Birdwatching tower	2	40	429 185
Small lookout tower	3	60	1 256 898
Lookout tower	1	20	653 996
Total cost			**3 603 108**

2.5.2 Combination of scenarios

Scenario II combines physical recreation, free time activity and biking trails. Therefore, this scenario includes the realisation of the objects mentioned in Scenario I and the realisation of biking trails mentioned in Scenario III. Only the total cost will be different.

This scenario is the most ambitious, as it will be the most financially demanding in terms of investment and subsequent operation. On the other hand, it will provide visitors to the site with more variety and diversity of activities. Sports-oriented individuals and families with children who want to spend a pleasant day in a beautiful, revitalised area near their city will find the opportunity to enjoy themselves here.

Following the plan from Scenario I, 23 objects measuring 5 x 4 m will be built along the lake's entire length. Following Scenario III, the Milada BikeCenter will be made with all individual parts, including Pump Tracks, Skill Center, Jumps, Shelter, and Trails. An area of 900.28 ha corresponds to this scenario.

Table 2-27 presents the investment costs for this scenario.

Table 2-27. Investment costs for a Combination of scenarios in Chabařovice Mine

Item	Quantity	Total m^2	Costs EUR
Small shelter with sitting and information	7	140.00	429 185
Picnic shelter	4	80.00	294 298

Elevated shelter	6	120.00	539 546
Birdwatching tower	2	40.00	429 185
Small lookout tower	3	60.00	1 256 898
Lookout tower	1	20.00	653 996
Pumptrack	2	600.00	136 947
Skillcenter	2	2730.00	43 539
Jumps	3	1880.00	69 354
Trails	3	4510.00	136 722
Shelter	1	9.50	8 220
Total cost			**3 997 890**

2.5.3 Sports

One of the plans is the realisation of the Milada Bikecenter sports ground. Downhill and uphill trails with technical elements are designed for the area of the slope facing south above the water surface of Lake Milada. A pump track and a skills centre for improving riding skills are proposed under the trails. The area is currently grassed over without use, and the slope is artificially created as part of the reclamation. The Bikecenter will serve as a public sports ground for leisure activities and a recreation area. The sports grounds are mainly for cycling, pump track, and riding on skateboards, skates, or scooters. The Bikecenter is designed to serve all users, regardless of age or advanced level of riding:

- **Pumptrack:** It is an asphalt surface pump track course composed of waves and banked turns. The construction of the pump track is realised by piling up and compacting the foundation from a well-compactable material, gravel. After the overall modelling of the runway, an asphalt surface will be used on the upper driving layer.

- **Skill centre**: The skill centre is made up of obstacles for improving technical bike ride skills. The designed elements are made up of natural elements made of wooden parts (larch, pine, or spruce) and stones placed freely on flat terrain. Wooden obstacles will be made of wooden elements folded into routes in combination with stones, and individual elements will be placed on the ground in a gravel bed or on mats. The parts will be anchored to the ground against displacement using ground screws.

- **Jumps**: There are three jump tracks of different difficulties. The jumps are clay constructions like the trail and the foundation of the pump track. All tracks share the starting area at the western lower part of the Bikecenter. The jumps connect again at the end of the existing connecting footpath.

- **Shelter**: Modular system of steel-wood construction based on steel footings and a gravel cushion. The structure comprises wooden posts and 80 x 80 mm beams connected by steel connectors. The wooden elements will be provided with an oil-based protective colourless coating. Polycarbonate will be used for the roof, alt. metal roofing. The shelter is covered on two sides by a leeward blind equipped with two benches.

- **Trails**: Routes on a slight slope with turns and minor bumps and jumps. Trails are designed with graded difficulty, from beginner to advanced. From the upper part, the Green connecting Trail 1 leads to the two main Trails, 2 and 3 (Blue and Red), which are run concurrently in two lengths separated by a path. The blue trail is easier, and the red trail is of greater difficulty with more jumps and technical elements. Both trails end in the lower part of the area above the lake, where they are connected to the climbing trail or the lower part of the Bikecenter with jumps, skill centre and pump track.

The work on the trail will mainly consist of earthworks, removal of the organic layer, surface treatment, levelling of the soil, cutting into the slope up to a maximum height of 1.5 m, compaction of the road surface, filling in depressions, strengthening of waterlogged areas, removal of surface water from puddles, drainage, preventing surface water from washing the surface.

In terms of construction, it will mainly involve the implementation of earthworks and landscaping consisting of the construction of paved paths with a width of 0.6 to 1.8 m with natural aggregate and soil. The entire trail will be built by machine with the help of an excavator of up to 5 t. Due to drainage, several places in the flatter passages will have to be raised above the ground using imported material. The trail surface will be natural from compacted gravel with a thickness of 3-5 cm, or only the surface left after removing the rake in less stressed parts.

An area of 900.28 ha corresponds to this scenario. Table 2-28 presents the investment costs for Scenario III.

Table 2-28. Investment costs for Sports in Chabařovice Mine

Item	Built-up area (m^2)	Costs EUR
Pumptrack	600	136 947
Skill centre	2730	43 539
Jumps	1880	69 354
Trails	4510	136 722
Shelter	9.50	8220
Total cost		**394 782**

3 Maintenance costs

3.1 Figaredo Mine

3.1.1 Fibre production

The pine plantation holes must be sanitised, and topsoil must be added. Trees should be planted with a tutor and protective netting.

Afterwards, during the first months after planting, maintenance and watering must be carried out, followed by annual maintenance for at least five years, which includes the following tasks:

- Weeding around each plant for a perimeter of about one metre.
- Hand weeding around the tree.
- Breaking up large clumps.
- Fertilising with slow-release fertiliser, giving each tree a minimum of 150 g of fertiliser and checking the condition of the stakes.

In addition, it is advisable to rinse once a week in the warmer season, with a water supply of about 35 litres per watering plant. The estimated maintenance costs calculated by HUNOSA are presented in Table 3-1.

Table 3-1. Plantation maintenance costs

Item	EUR/m^2	EUR/ha
Clearing and cleaning/year	0.045	450
Slow-release fertiliser/year	0.020	200
Watering/year	0.013	130
Total cost		**780**

3.1.2 Food production

In Asturias, 1 ha for feeding cows for meat production will need 300 EUR/year of additional feed costs such as dry grass and feed.

3.1.3 Broad-leaved forest

As in the case of Fibre production, the estimated maintenance costs calculated by HUNOSA are the ones already presented in Table 3-1: 780 EUR/ha.

3.2 Janina Mine

3.2.1 Increasing the natural and recreational potential

Three years after planting, the removal of vegetation around the shrub seedlings is needed, and this maintenance action has to be carried out twice a year. The cost of this work is estimated at 14 200 EUR/ha. During the first three years after shrubs planting, fencing against animals is necessary, and the cost of installing forestry mesh fences is estimated at 0.69 EUR/m^2.

To encourage perennial flowers and grasses to make good root development, remove surplus growth and help the wildflowers to persist, it is essential to mow the meadow two times per year (in Spring and in Autumn). The regular cutting of wildflower meadows allows for removing weeds and dominant species.

The cost of cutting and harvesting biomass from meadows and land is estimated at 200 EUR/ha/year). The traditional lawn needed to mowing at least three times a year (300 EUR/ha/year). In the case of wetland vegetation, the cost of maintenance cutting and harvesting is estimated at 400 EUR/ha. To protect animals associated with wetland ecosystems, rushes should be cut on only 25% of rush vegetation.

The service cost includes repair of minor infrastructure maintenance and is estimated as 5% of the total investment cost. The entire maintenance costs for Scenario I are presented in Table 3-2.

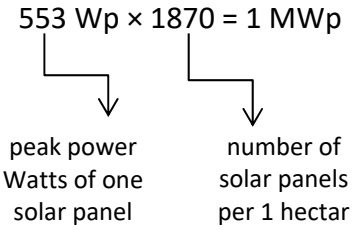
Table 3-2. Maintenance costs of Increasing the natural and recreational potential in Janina Mine

Item	EUR/m^2	EUR/ha	Area (ha)	Cost (EUR)
Green urban areas			**5.52**	**29 532**
Mowing the meadow (twice a year)	0.20	2 000	4.97	9936
Cost of minor infrastructure maintenance (5% of investment cost)	3.55	35 500	0.55	19 596
Transitional woodland-shrub			**19.96**	**283 432**
Clearing shrubs (first three years after planting)	1.42	14 200	19.96	283 432
Natural grassland			**19.97**	**3 994**
Mowing the meadow (twice a year)	0.2	200	19.97	3994
Sport and leisure facilities (7.34)			**7.34**	**16 882**
Cost of minor infrastructure maintenance	5.30	5300	2.94	15 560
Mowing the lawn (3 times a year)	0.30	300	4.40	1321

Water bodies			**15.72**	**157**
Mowing and harvesting wetland vegetation (once a year on 25% area covered by vegetation)	0.4	400	0.393	157.20
TOTAL COST				**333 997.20**

3.2.2 Increasing the economic potential

According to the market prices, the cost of a PV installation service is estimated at 6383 EUR/MWp/year. Assuming that 1MWp will be produced per 1 ha of solar panels installation, maintenance costs of Scenario II are as follows:



Thus, the cost of PV service was estimated as 6383 EUR/ha/year.

The total maintenance cost for scenario II is presented in Table 3-3.

Table 3-3. Maintenance costs of Increasing the economic potential in Janina Mine

Item		EUR/m^2	EUR/ha	Area (ha)	Cost (EUR)
	Construction sites			**50.1**	**399 948**
Solar energy panel maintenance		0.6383	6383	50.1	319 788
Mowing the meadow (twice a year)		0.2	2000	40.08	80 160
	Industrial or commercial units			**6.42**	**24 075**
Road maintenance		2.1	21 000	0.963	20 223
Mowing the meadow (twice a year)		0.2	2000	1.926	3852
	TOTAL COST				**424 023**

3.2.3 Increasing the natural, recreational and economic potential

The individual maintenance cost for Scenario III includes the costs described in Scenario I and Scenario II. The total maintenance costs for Scenario III are presented in Table 3-4.

Table 3-4. Maintenance costs of Increasing the natural, recreational and economic potential in Janina Mine

Item	EUR/m^2	EUR/ha	Area (ha)	Cost (EUR)
Green urban areas			**7.36**	**39 376**
Mowing the meadow (twice a year)	0.20	2000	6.624	13 248
Cost of minor infrastructure maintenance (5% of investment cost)	3.55	35 500	0.736	26 128
Transitional woodland-shrub			**18.97**	**269 374**
Clearing shrubs (first three years after planting)	1.42	14 200	18.97	269 374
Natural grassland			**17.09**	**3418**
Mowing the meadow (twice a year)	0.2	200	17.09	3418
Sports and leisure facilities			**6.14**	**14 122**
Cost of minor infrastructure maintenance	5.30	5300	2.456	13 016
Mowing the lawn (3 times a year)	0.30	300	3.684	1105
Water bodies			**9.96**	**99**
Mowing and harvesting wetland vegetation (once a year on 25% area covered by vegetation)	0.4	400	0.249	99
Construction sites			**4.55**	**36 323**
Solar energy plant maintenance	0.64	6383	4.55	29 043
Mowing the meadow (twice a year)	0.2	2000	3.64	7280
Industrial or commercial units			**4.45**	**1669**
Road maintenance	2.1	2100	0.667	1402
Mowing the meadow (3 times a year)	0.2	200	1.335	267
TOTAL COST				**364 381**

3.3 Ema-Terezie Mine dump complex

3.3.1 Recreation

The following maintenance costs are foreseen for this scenario:

- Planting maintenance by weeding at areas planted 300 trees/ha.
- Replenishment of dead plants in planting (30 trees/ha).
- Clearing (garbage) and waste collection from trash cans.

Maintenance will be applied only on the same part of the solved area. Table 3-5 presents the costs of items per ha and the percentage of the extension where the item should be applied. Care about plants will be done once per year, and waste collection from trash cans will be done monthly. These periods were considered in the calculation of the costs.

Table 3-5. Maintenance cost for Mixed Forest in Ema-Terezie

Item	EUR/m^2	EUR/ha	Applied on % of the designed CLC (CLC: 313)
Planting maintenance by weeding in areas planted 300 trees/ha	0.026	260.00	2.13%
Replenishment of dead plants by planting 30 trees/ha	0.0036	36.00	2.13%
Clearing (garbage), waste collection from trash cans	0.0198	198.38	100%

The maintenance is calculated for five years after investment because of the reclamation cycle of 5 years. The mean cost representing each hectare homogeneously (for applying some items to smaller specific areas) was calculated.

Table 3-6 presents the mean maintenance costs for Mixed Forest (CLC: 313) in Scenario I.

Table 3-6. Mean maintenance costs for Mixed Forest (CLC: 313) in Ema-Terezie

Item	EUR/ha
Planting maintenance by weeding in areas planted 300 trees/ha	5,54
Replenishment of dead plants by planting 30 trees/	0.77
Clearing (garbage), waste collection from trash cans	198.38
Total EUR (CLC: 313)	**204.69**

Maintenance cost for CLC: 313 in 5 years after investments are estimated at 204.67 EUR/ha.

3.3.2 Combination of land use intentions

The following maintenance costs are foreseen in this scenario:

- Planting maintenance by weeding – at areas planted 300 trees/ha.
- Replenishment of dead plants in planting (30 trees/ha).
- Clearing (garbage) and waste collection from trash cans.

- Grass cutting, including removal (grazing and mowing).

Maintenance costs for the area with family houses and horse trails are not evaluated, and their owners and tenants will do it.

Maintenance is planning to apply only to the same part of the solved area. Table 3-7 presents the costs of items per hectare and the percentage of the extent to which the item should be applied. Care about plants will be done once per year, and waste collection from trash cans will be done monthly. These periods were considered in the calculation of the costs. We count the same number of trash cans as in Scenario I. But it was more concentrated in an area with suggested land use Sports and leisure facilities and Mixed Forest.

Table 3-7. Maintenance costs for Combination of land use intentions in Ema-Terezie

Item	EUR/m^2	EUR/ha	Applied on % of the designed CLC
Planting maintenance by weeding in areas planted 300 trees/ha	0.026	260.00	3,35% for CLC=313
Replenishment of dead plants by planting 30 trees/	0.0036	36.00	3,35% for CLC=313
Clearing (garbage), waste collection from trash cans	0.0223	223.00	100% for CLC=142 100% for CLC=313
Grass cutting, including removal (grazing and mowing)	0.026	260.00	30% for CLC=142 100% for CLC=231

The maintenance is calculated for five years after investment because of the Reclamation cycle of 5 years. The mean cost representing each hectare homogeneously (for applying some items to smaller specific areas) was calculated.

The mean maintenance costs for Sports and leisure facilities (CLC: 142) in Scenario II are presented in Table 3-8.

Table 3-8. Mean maintenance costs for Sports and leisure facilities (CLC: 142) in Ema-Terezie

Item	EUR/ha
Clearing (garbage), waste collection from trash cans	223.00
Grass cutting, including removal (grazing and mowing)	78.00
Total EUR (CLC: 313)	**301.00**

The mean maintenance costs for Pastures (CLC=231) in Scenario II are presented in Table 3-9.

Table 3-9. Mean maintenance costs for Pastures (CLC: 231) in Ema-Terezie

Item	EUR/ha
Grass cutting, including removal (grazing and mowing)	260.00
Total EUR (CLC: 231)	**260.00**

The mean maintenance costs for Mixed Forest (CLC=313) are presented in Table 3-10.

Table 3-10. Mean maintenance costs for Mixed forest (CLC: 313) in Ema-Terezie

Item	EUR/ha
Planting maintenance by weeding in areas planted 300 trees/ha	8.71
Replenishment of dead plants by planting 30 trees/	1,21
Clearing (garbage), waste collection from trash cans	223,00
Total EUR (CLC: 313)	**232.92**

3.3.3 Forest park

The following maintenance costs were foreseen in this scenario:

- Planting maintenance by weeding – at areas planted 300 trees/ha.
- Replenishment of dead plants in planting (30 trees/ha).
- Clearing (garbage) and waste collection from trash cans.
- Grass cutting, including removal (grazing and mowing).

Maintenance is planning to apply only to the same part of the solved area. Table 3-11 presents the costs of items per hectare and the percentage of the extent to which the item should be applied. Care about plants will be done once per year, and waste collection from trash cans will be done monthly. These periods were considered in the calculation of the costs.

Table 3-11. Maintenance costs for Forest park in Ema-Terezie

Item	EUR/m^2	EUR/ha	Applied on % of the designed CLC
Planting maintenance by weeding in areas planted 300 trees/ha	0.026	260.00	2.15% for CLC: 313
Replenishment of dead plants by planting 30 trees/	0.0036	36.00	2.15% for CLC: 313
Clearing (garbage), waste collection from trash cans	0.020	200.00	100% for CLC: 313
Grass cutting, including removal (grazing and mowing)	0.026	260.00	100% for CLC: 231

The maintenance is calculated for the five years after investment because of the Reclamation cycle of 5 years. The mean cost representing each hectare homogeneously (for applying some items to smaller specific areas) was calculated.

Table 3-12 presents the mean maintenance costs for Pastures (CLC: 231) per ha in Scenario III.

Table 3-12. Mean maintenance cost for Pastures (CLC: 231) in Ema-Terezie

Item	EUR/ha
Grass cutting, including removal (grazing and mowing)	260,00
Total EUR (CLC: 231)	**260,00**

Finally, Table 3-13 presents the mean maintenance cost for Mixed Forest (CLC: 313) per ha in Scenario III.

Table 3-13. Mean maintenance cost for Mixed Forest (CLC: 313) in Ema-Terezie

Item	EUR/ha
Planting maintenance by weeding in areas planted 300 trees/ha	5.59
Replenishment of dead plants by planting 30 trees/	0.77
Clearing (garbage), waste collection from trash cans	200,00
Total EUR (CLC: 313)	**206.36**

3.4 Most-Ležáky Mine

3.4.1 Recreation

After completion of the Lookout, regular inspection and maintenance of the condition are required to ensure function and safety. One employee will be considered. The annual salary for one employee is 23 912 EUR with all statutory contributions. The employee will perform an inspection, possible maintenance, and repairs but also ensure the cleanliness of the environment.

Operating cost of a car already used for similar needs of the DIAMO s.p., o.z. PKÚ are 0.31 EUR/km. The price includes the cost of fuel, depreciation, and service. The employee will travel five times per week from Kohinoor to Lake Most to the Lookout, approximately 14 km per day. Specific tools, equipment and material for maintenance will be purchased. The total cost of materials and equipment is 900 EUR per year.

An area of 193 ha corresponds to this scenario (Polygon 12).

The costs per year are presented in Table 3-14.

Table 3-14. Mean maintenance cost for Recreation in Most-Ležáky Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.0124	123.89
Car/year	0.0006	5.78
Equipment and material	0.0005	4.66
Total costs	**0.0135**	**134.33**

3.4.2 Combination of scenarios

The maintenance costs in the combination of scenarios correspond to the sum of Scenarios I and III expenses. These are specific activities that cannot be saved by having one employee perform various jobs to save costs. The demands on human resources will be the greatest in this scenario – different employees will be delegated to each activity. The total cost of materials and equipment is 5 250 EUR/year.

An area of 1166 ha corresponds to this scenario (Polygons 6, 8-28, 39-42).

The costs per year are presented in Table 3-15.

Table 3-15. Mean maintenance cost for a Combination of scenarios in Most-Ležáky Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.01672	167.21
Car/year	0.00102	10.24
Equipment and material	0.00061	6.12
Monitoring fish stock	0.00332	33.18
Total costs	**0.02167**	**216.75**

3.4.3 Nature

Regular maintenance costs include expenses for monitoring fish stock and eventual restoration, whether due to natural death or poaching. Compliance with the fishing ban and control of the behaviour of lake visitors will be ensured daily by a guard service. The total cost of monitoring fish stock is 10 218 EUR/year, which the contractor will carry out. The total water area is 308 ha (Polygon 6).

Asphalted surfaces used for sporting and touristic enjoyment of lake visitors will be checked regularly and, if necessary, restored to their original condition with repairs. It will not be easy to accurately calculate these expenses in advance, as the repairs will not occur at regular intervals but according to the current technical condition.

Basic landscaping around the sports and hiking trails will include grass cutting, which will take place from spring to Autumn approximately once a month, depending on rainfall, and pruning of invasive trees, which will be carried out in the spring and will take about one month, as well as waste cleaning, which will be performed five times a week.

Permanent employees of the operator will ensure all these activities. Five employees will be considered. The annual salary for one employee is 23 912 EUR with all statutory contributions. The cost of a car is calculated at 0.31 EUR/km, the total cost is 7673 EUR/year, and the total cost of material and equipment is 4350 EUR/year. The total land area is 858 ha (Polygons 8-28, 39-42).

An area of 1166 ha corresponds to this scenario (land area 858 ha, water area 308 ha).

The costs per year are presented in Table 3-16.

Table 3-16. Mean maintenance cost for Nature in Most-Ležáky Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.01393	139.35
Car/year	0.00089	8.94
Monitoring fish stock	0.00332	33.18
Equipment and material	0.01268	126.77
Total costs	**0.03082**	**308.39**

3.5 Chabařovice Mine

3.5.1 Recreation

After the construction of the objects is completed, regular inspection and maintenance of the condition are necessary to ensure their function and safety. Two employees will be considered, who will check and ensure the cleanliness of the environment around the objects. The annual salary for one employee is 23 912 EUR with all statutory contributions. Operating costs of a car that is already used for similar needs of the DIAMO s. p., o. z. PKÚ are 0.31 EUR/km. The price includes the cost of fuel, depreciation, and service.

The employees will travel from the company to Lake Milada. During the day, five times per week, the employees will visit all the places around the lake where the objects will be placed, approximately 33 km per day. Specific tools, equipment and material for maintenance will be purchased, and the annual cost of materials and equipment is 1100 EUR.

An area of 900.28 ha corresponds to this scenario (Polygons 3-6, 21-22, 34, 41-42).

The costs per year are presented in Table 3-17.

Table 3-17. Mean maintenance costs for Recreation in Chabařovice Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.005312	53.12
Car/year	0.000039	0.39
Material and equipment	0.000114	1.14
Total costs	**0.005465**	**54.65**

3.5.2 Combination of scenarios

After the completion of all objects and the commissioning of the Bikecenter, regular inspection and maintenance of the condition, including the surrounding terrain, where green maintenance and cleaning work will take place, is necessary. This will ensure trouble-free functionality and the safety of the built elements in the entire area.

We will employ four employees who will perform an inspection, possible maintenance, and repairs, but also ensure the cleanliness of the environment. The annual salary for one employee is 23 912 EUR with all statutory contributions.

Operating cost of a car already used for similar needs of the DIAMO s.p., o.z. PKÚ are 0.31 EUR/km. The price includes the cost of fuel, depreciation, and service. The employees will travel from the company to Lake Milada to the Bikecenter and all the places around the lake where the shelters will be located, approximately 53 km per day. Specific tools, equipment and material for maintenance will be purchased. The total cost of material and equipment is 2578 EUR per year.

An area of 900.28 ha corresponds to this scenario (Polygons 3-6, 21-22, 34, 41-42). The costs per year are presented in Table 3-18.

Table 3-18. Mean maintenance costs for a Combination of scenarios in Chabařovice Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.0106	106.24
Car/year	0.0005	4.69
Material and equipment	0.0003	2.86
Total costs	**0.0114**	**113.79**

3.5.3 Sports

After completing the construction and commissioning of the Bikecenter, regular inspection of the terrain and maintenance of the condition of individual parts is necessary to ensure function and safety. In addition, there will be the cost of maintenance of greenery and cleaning work in the area. We will employ two employees, and the annual salary for one employee is 23 912 EUR with all statutory contributions.

Operating cost of a car already used for similar needs of the DIAMO s.p., o.z. PKÚ are 0.31 EUR/km. The price includes the cost of fuel, depreciation, and service. The employees will travel from the company to Lake Milada to the Bikecenter, approximately 20 km per day. The Bikecenter will be freely accessible, without fencing and staff. Specific tools, equipment and material for maintenance will be purchased. The total cost of material and equipment is 1289 EUR per year.

An area of 134 ha corresponds to this scenario (Polygon 4).

The costs per year are presented in Table 3-19.

Table 3-19. Mean maintenance costs for Sports in Chabařovice Mine

Item	EUR/m^2	EUR/ha
Salary/year	0.0357	356.89
Car/year	0.0012	11.90
Material and equipment	0.0010	9.62
Total costs	**0.0379**	**378.41**

4 Conclusions and lessons learned

In this Deliverable, the investment and maintenance costs for the different scenarios considered for the five case studies (Figaredo Mine in Spain, Janina Mine in Poland, and Ema-Terezie, Most-Ležáky Mine and Chabařovice Mine in the Czech Republic) were specified, collected and calculated.

The lessons relevant to RECOVERY from the collection of investment and maintenance costs can be summarised as follows:

1. Although it is interesting to present costs in EUR/m^2 and EUR/ha, in some cases, such as constructions, roads, shelters, etc., costs in EUR/m^2 do not have a physical significance.

2. Sunk costs are not necessary to be considered when calculating to decide which options (scenarios) will provide the most significant benefits. However, the stakeholders need to know the exact costs they will incur during the restoration process.

3. It is essential to specify the precise area involved in the cost or the percentage that applies in the designed CLC to facilitate subsequent NPV calculations.

5 Glossary

CAPM: Capital asset pricing model

CICES: Common International Classification of Ecosystem Services

CLC: Corine Land Cover

EIA: Environmental Impact Assessment

ES: Ecosystem services

EU: European Union

EURIBOR: Euro Interbank Offered Rate

GCD: Global credit data

HUNOSA: Hulleras del Norte, S.A.

TEEB: The Economics of Ecosystems and Biodiversity

NPV: Net present value

PKÚ: Palivový Kombinát Ústí

PV: Photovoltaic

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