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Conservation and promotion of the Coal Mining Heritage as Europe's cultural legacy

Deliverable 4.1
Coal heritage Geodatabase

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EXECUTIVE SUMMARY

The present deliverable focuses on the collection and homogenization of geospatial data and related texts from selected coal mines sites in countries that are participating in CoalHeritage project (German, Greece, France, Poland, Slovenia). These data serve as input for the European Visual Map Journal (EVMJ), which is under development for Task 4.2. Specifically, a geodatabase was devolved for the cloud-based platform to integrate the collected and homogenized data as tables (Excel format) and as features classes, following to the ESRI Standard. The database includes both spatial (e.g., boundaries, mining area boundaries, coal heritage sites) and non-spatial information (e.g., texts, photos, videos). This database supports the development of narrative and interactive content for the coal mining heritage sites in German, Greece, France, Poland, and Slovenia based on the ArcGIS Online platform. In general, the developed geospatial datasets consist of 5 feature classes from tasks 2.1 and 3.3. These datasets contain 2D sites representing open-pit mine boundaries, machines utilized in coal mines, infrastructures related to mines, as well as 3D digital models of coal heritage assets. The data are maintained in a cloud-based database and can be accessed for download upon request. Available for public download, 99 spatial entities have been selected and uploaded after reaching a consensus among all partners to the European Geological Data Infrastructure (EGDI).

1. INTRODUCTION

This report presents Deliverable 4.1 “Coal heritage Geodatabase”. Specifically, this document includes the collection and the homogenization of the geospatial data (Figure 1.1), derived reports, multimedia and supplementary material from the selected sites in German, Greece, France, Poland, and Slovenia as an input for the European Visual Map Journal (EVMJ) that is under progress for Task 4.2. This deliverable provides a detailed description of the data from the implemented tasks of 2.1 and 3.3.

Figure 1.1 Illustrated features of the CoalHeritage database. Map data: Esri, TomTom, Garmin, FAO, NOAA, USGS; Esri, USGS.

In relation to these tasks, geospatial data were collected and homogenized into a geodatabase in order to be hosted and visualized in to the cloud-based platform. To ensure homogenization geospatial data were organized in both attribute tables (Excel format) and shapefiles/feature classes in accordance with the ESRI standard. The selected coordinate reference system was the ETRS89 (European Terrestrial Reference System), aligning with the recommendations of the WFD GIS Working Group and the INSPIRE directive for panEuropean spatial data collection, storage, and analysis. The database was developed using ESRI’s commercial software package ArcGIS Online, and ArcGIS Pro 3.3. The visualized material is available online in the following link:
https://storymaps.arcgis.com/collections/987904b97d664cedb2ea4c161fb0f31e.

Particularly, the database (Table 1.1) includes both spatial (e.g., mining area boundaries, coal heritage sites, infrastructures) and non-spatial information (e.g., texts, photos, videos). Specifically, the collected and processed texts, photos, and videos will be part of the material for the narrative storytelling maps, which will be delivered at the end of the project. This material has been utilized for developing narrative stories for the coal mining heritage sites in German, Greece, France, Poland, and Slovenia on the ArcGIS Online platform. All the non-spatial data used in the storytelling maps has been visualized and converted into PDF files, and are available online in the aforementioned folder. The organized geodatabase is available online at https://certh.maps.arcgis.com/home/item.html?id=2ae258a4ec28453c83109996853a9019. This geodatabase consists of 99 publicly available spatial entities, collected from WP2 & WP3 as points of interest related to coal mine history and assets. Specifically, 344 spatial entities were gathered in total, with additional geospatial data collected for visualization purposes; however, these are not included in the public geodatabase and will be presented in the deliverable.

Table 1.1 List of data sources for European Visual Map Journal by type.

Type (Spatial / Non-Spatial)	Data layer/description	Source / related
Sites related to Coal Mine Heritage	Vector file / point	Task 2.1 & 3.3
3D assets	gbl	Work Package 2 & 3
Regional boundaries	Vector file / polygon	https://gadm.org/
Coal mine boundaries	Vector file / polygon	Corine Land Cover (CLC)
Linear graphs of Šalek Valley	Vector file / polyline	PREMOGOVNIK VELENJE DOO
Status quo of coal mining heritage in Europe	Texts & Images	Work Package 2

2. DATA VISUALIZATION

For the geospatial dataset, a geodatabase (Figure 2.1) of 5 feature datasets, was created based on the tasks 2.1 and 3.3. Specifically, those feature classes were developed and categorized by country. Each national database includes various shapefiles (in vector format), that are illustrating spatial entities which are related to coal mines in each country. Specifically, these shapefiles are:

- regional and/or open-pit mine boundaries
- Infrastructures
- Machines
- Sites related to coal mines

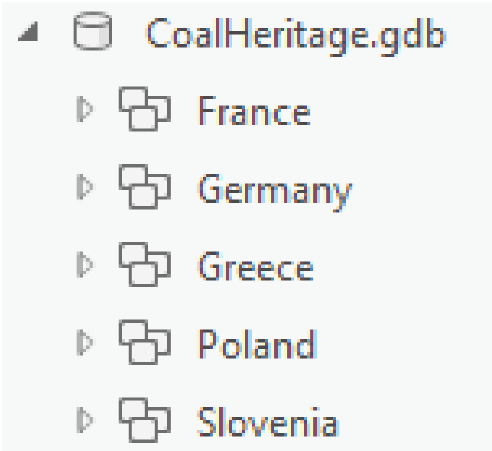

Figure 2.1 Schema of the geodatabase structure **(CoalHeritage.gdb)** that was developed during the project.

In particular, the regional and/or open-pit mine boundaries (polygons) are specifically located in France and Greece. These data were georeferenced and digitized by maps provided by France partners (BRGM) and regarding the Greek sites, were developed and processed (CERTH) form the available open source databases of the Corine Land Cover. The rest types of spatial entities were provided from all the partners according to the recorded available data (points & lines). More specifically, in Slovenia are existing available linear vector files (lines) that are depicting the spatiotemporal evolution of underground processes, as well as 3D assets from Polish sites that are illustrating the existing machines and infrastructures providing a virtual visualization of these assets. It should be mentioned that all the 3D assets of the project were collected and archived into a second geodatabase title as **FINAL_3D_MODELS_SCALED.gdb** (Figure 2.2). This second geodatabase was developed in order to visualize the 3D assets within the EVJM platform but are not available for download.

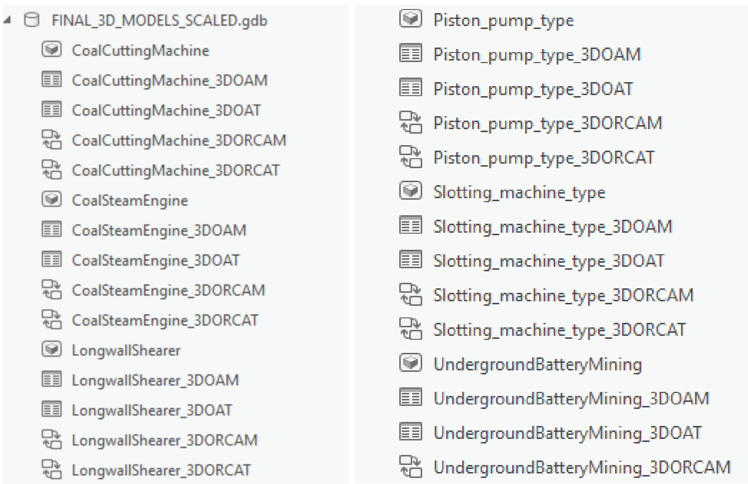

Figure 2.2 Schema of the 3D geodatabase structure **(FINAL_3D_MODELS_SCALED.gdb)** that was developed during the project.

The following tables and figures provide detailed information about the first geodatabase, including the number of layers and their descriptions. The first feature dataset, named **France**, contains the following vector layers (Table 2.1 & Figure 2.3):

Table 2.1 Descriptive table of shapefiles from the **France** feature dataset.

Feature	Description
FR_boundaries	Regional and department boundaries of Frances that were utilized for illustration purposes.
FR_Coalfields	Coalfield areas boundaries that were digitized from maps to visualize a historic archive of coal mine activity in France.
FR_sites	Points of interest that were collected as CoalHeritage sites representing the Coal mine heritage of each country.

Figure 2.3 Visualization of shapefiles from the feature dataset, titled **France**.

The second feature dataset, named **Germany**, contains, contains the following vector layers (Table 2.2 & Figure 2.4):

Table 2.2 Descriptive table of shapefiles from the **German** feature dataset.

Feature	Description
GER_sites	Points of interest that were collected as CoalHeritage sites representing the Coal mine heritage of each country.

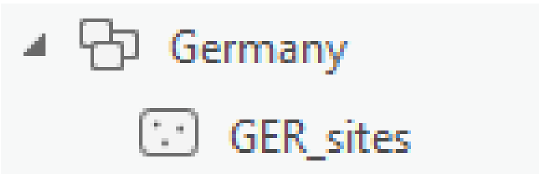

Figure 2.4 Visualization of shapefiles from the feature dataset, titled **Germany**.

The second feature dataset, named **Greece**, contains, contains the following vector layers (Table 2.3 & Figure 2.5):

Table 2.3 Descriptive table of shapefiles from the **Greece** feature dataset.

Feature	Description
GR_mines_CLC2018	Boundaries of areas that are related with coal mine activity (Operating or Preserved) in Greece according to the Corine Land Cover 2018.
GR_Sites	Points of interest that were collected as CoalHeritage sites representing the Coal mine heritage of each country.

Figure 2.5 Visualization of shapefiles from the feature dataset, titled **Greece**.

The second feature dataset, named **Poland**, contains, contains the following vector layers (Table 2.4 & Figure 2.6):

Table 2.4 Descriptive table of shapefiles from the **Poland** feature dataset.

Feature	Description
PL_sites	Points of interest that were collected as CoalHeritage sites representing the Coal mine heritage of each country.

Figure 2.6 Visualization of shapefiles from the feature dataset, titled **Poland**.

The second feature dataset, named **Slovenia**, contains, contains the following vector layers (Table 2.5 & Figure 2.7):

Table 2.5 Descriptive table of shapefiles from the **Slovenia** feature dataset.

Feature	Description
PV_mine_map_2015	Spatiotemporal drawings of Šalek Valley pit-mine network above and underground the surface.
PV_mine_map_2016	
PV_mine_map_2017	
PV_mine_map_2018	
PV_mine_map_2019	
PV_mine_map_2020	
PV_mine_map_2021	
PV_mine_map_2022	
PV_mine_map_2023	
PV_mine_map_2024	
SL_sites	Points of interest that were collected as CoalHeritage sites representing the Coal mine heritage of each country.

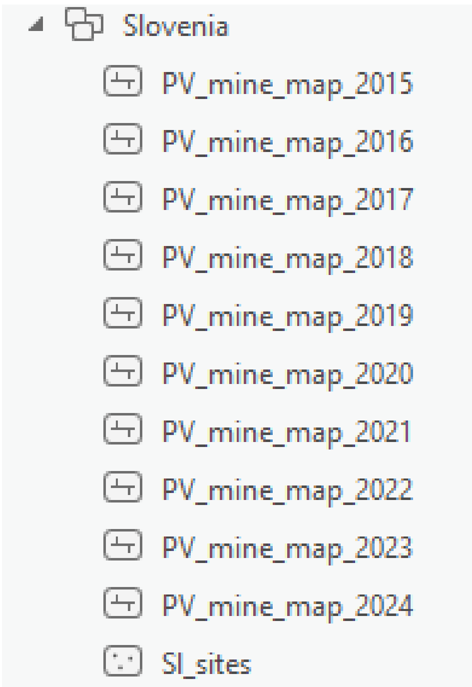

Figure 2.7 Visualization of shapefiles from the feature dataset, titled **Slovenia**.

3. GEOSPATIAL DATASET DESCRIPTION

The following section provides a description of the geospatial data included in the feature datasets. Each country has multiple geospatial datasets that follow their specific characteristics and requirements. Additionally, within each country, there is a shapefile that follows a consistent structure with shared attributes, including:

- **OBJECTIVEID (ID):** A unique identifier for each record in the dataset.
- **Shape (Geometry):** The shape of the spatial entities witch are Points.
- **ID (Long):** A unique identifier for the whole dataset.
- **Name (Text):** The name of the mining site or park.
- **Latitude (DD) (Double):** The latitude coordinates of the site in decimal degrees.
- **Longitude (DD) (Double):** The longitude coordinates of the site in decimal degrees.
- **Active Period (Text):** The period during which the site was active for mining or other activities.
- **Mine Status (Text):** Indicates whether the site is preserved, abandoned, operating, or has no data available.
- **Mining activity (Text):** Describes the type of mining activity which can be Underground, Surface Mining, Underground and Surface Mining, or none of the above (None).
- **Available Facilities (Text):** Lists the facilities and amenities available at the site for visitors or activities.
- **Type (Text):** Specifies the type of site, such as infrastructure, mining area, or machine.
- **Country (Text):** Indicates the country where the site is located.

These consistently structured shapefiles specifically represent the sites related to coal mining heritage, while the other datasets highlight additional geospatial aspects pertinent to each country's unique context. Each dataset represents the sites related to coal mining heritage in different countries, and they are described as follows:

I. France

The first feature dataset with the title “France” includes 3 features regarding the mining areas and the regional boundaries of the CoalHeritage project. Specifically, the shapefile of the FR_Coalfields (Polygon) (Table 3.1 & Figure 3.1) consist of 135 entities that illustrating the boundaries of coalfields in the wider area of France. Due to the purpose of this layer was the simplified visualization of the coal sites, the attribute table contains the default spatial attributes that are generated during the processing of this product such as a unique ID number, Shape, Shape_length and Shape_Area. In future steps of the project is possible the development of an additional attribute regarding the name of each sites whenever are possible. It should be mentioned that the number of sites as well as the length and area in not necessary illustrating the current sate in France.

Table 3.1 Descriptive table of shapefiles from the "France" feature dataset.

Feature	Geometry Type	Number of Entities	Fields (type)
FR_Coalfields	Polygon	135	OBJECTID (Object ID), Shape (Geometry), Shape_Length (Double), Shape_Area (Double)
FR_boundaries	Polygon	96	OBJECTID (Object ID), FID (Object ID), Shape (Geometry), NAME_1 (Text), NAME_2 (Text), Class (Text), Shape_Length (Double), Shape_Area (Double)
FR_sites	Point	12	Active_period (Text), Mine_Status (Text), Mining_activity (Text), Available_Facilities (Text), Type (Text), Country (Text)

	OBJECTID *	Shape *	Shape_Length	Shape_Area
1	1	Polygon	25205,990078	45144036,866887
2	2	Polygon	8369,997451	3068712,263498
3	3	Polygon	1492,558688	58126,233096
4	4	Polygon	22509,07289	34842705,749285
5	5	Polygon	33015,821827	80502974,906437
6	6	Polygon	9462,269111	5263574,332001
7	7	Polygon	11613,514328	7437294,405053
8	8	Polygon	9439,146574	5547018,398099
9	9	Polygon	8190,702835	3928332,431377
10	10	Polygon	10885,510146	6863784,239462
11	11	Polygon	10424,360449	6601867,103297
12	12	Polygon	10574,411104	6544425,035887
13	13	Polygon	10540,741115	6406017,789066

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Figure 3.1 Visualization of the vector layer FR_Coalfields within the ArcGIS environment, from the feature dataset "France".

Additionally, the second shapefile title as FR_boundaries (Polygon), is about the department boundaries of France (Table 3.1 & Figure 3.2). Particularly, the attribute table provides information about the region that they belong (NAMES_1), the name of each department (NAMES_2), the class (Class) and the default attributes of Shape_Length and Shape_Area. Regarding the class attribute, as previously mentioned in FR_Coalfields layer, was created for visulazation purposes in order to highlight specific areas in EVJM platform. Under this light, some entities have specific class referred to specific colors (e.g., Blue, Grey, Yellow) and some others they don't (None).

	FID *	Shape *	NAME_1	NAME_2	Class	Shape_Length	Shape_Area
1	1	Polygon	Auvergne-Rhône-Alpes	Ain	None	478577,289845	5785414300,734514
2	2	Polygon	Auvergne-Rhône-Alpes	Allier	Orange	538995,912765	7380088567,446363
3	3	Polygon	Auvergne-Rhône-Alpes	Ardèche	None	432305,424843	5564737559,644226
4	4	Polygon	Auvergne-Rhône-Alpes	Cantal	Orange	514524,224143	5776218021,411407
5	5	Polygon	Auvergne-Rhône-Alpes	Drôme	None	641322,105546	6559408994,52821
6	6	Polygon	Auvergne-Rhône-Alpes	Haute-Loire	Orange	458399,792616	5004660685,806647
7	7	Polygon	Auvergne-Rhône-Alpes	Haute-Savoie	None	411826,197468	4881364328,148808
8	8	Polygon	Auvergne-Rhône-Alpes	Isère	Grey	610521,375747	7875548529,912965
9	9	Polygon	Auvergne-Rhône-Alpes	Loire	Yellow	513431,31131	4806385212,95062

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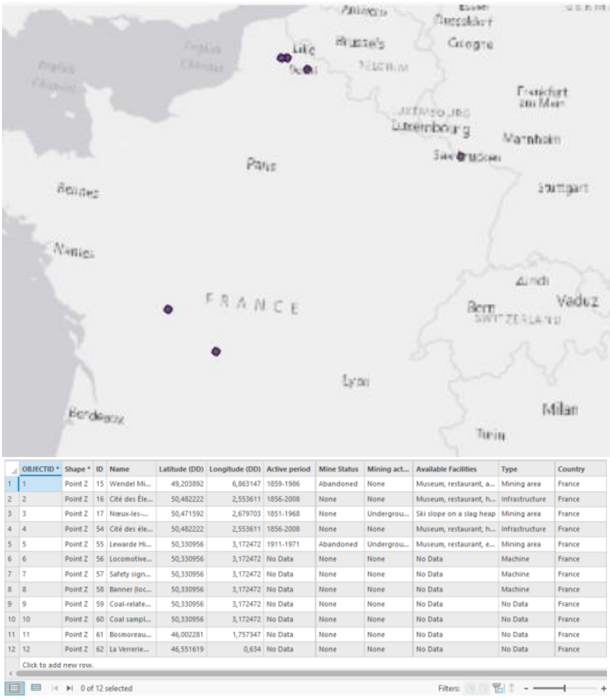
Figure 3.2 Visualization of the vector layer FR_boundaries within the ArcGIS environment, from the feature dataset "France".

Regarding the third shapefile (FR_sites) (Points), it represents the locations of sites related to the coal mining heritage of France. In particular, this vector layer consists of 12 entities (Table 3.1 & Figure 3.3) with an attribute table containing data regarding a unique code of the recorded sites (ID), the name (Name) of each site, coordinates in Decimal Degrees (Latitude (DD) & Longitude (DD)), the active period (Active period), the mine status (Mine Status), the mining activity (Mining Activity), the available facilities (Available Facilities), the type (Type) and the country (Country). Additionally, the attribute table contains some default attributes such as the OBJECTIVEID and Shape.



	OBJECTID *	Shape *	ID	Name	Latitude (DD)	Longitude (DD)	Active period	Mine Status	Mining act...	Available Facilities	Type	Country
1	1	Point Z	15	Wendel Mi...	49,203892	6,863147	1859-1986	Abandoned	None	Museum, restaurant, a...	Mining area	France
2	2	Point Z	16	Cité des Éle...	50,482222	2,553611	1856-2008	None	None	Museum, restaurant, h...	Infrastructure	France
3	3	Point Z	17	Nœux-les-...	50,471592	2,679703	1851-1968	None	Undergrou...	Ski slope on a slag heap	Mining area	France
4	4	Point Z	54	Cité des éle...	50,482222	2,553611	1856-2008	None	None	Museum, restaurant, h...	Infrastructure	France
5	5	Point Z	55	Lewarde Hi...	50,330956	3,172472	1911-1971	Abandoned	Undergrou...	Museum, restaurant, e...	Mining area	France
6	6	Point Z	56	Locomotive...	50,330956	3,172472	No Data	None	None	No Data	Machine	France
7	7	Point Z	57	Safety sign...	50,330956	3,172472	No Data	None	None	No Data	Machine	France
8	8	Point Z	58	Banner (loc...	50,330956	3,172472	No Data	None	None	No Data	Machine	France
9	9	Point Z	59	Coal-relate...	50,330956	3,172472	No Data	None	None	No Data	No Data	France
10	10	Point Z	60	Coal sampl...	50,330956	3,172472	No Data	None	None	No Data	No Data	France
11	11	Point Z	61	Bosmoreau...	46,002281	1,757347	No Data	None	None	No Data	No Data	France
12	12	Point Z	62	La Verrerie...	46,551619	0,634	No Data	None	None	No Data	No Data	France

Figure 3.3 Visualization of the vector layer FR_sites within the ArcGIS environment, from the feature dataset "France".

II. Germany

The second feature dataset title as "Germany" includes 1 feature regarding the sites that are related to coal mining heritage. In particular, the GER_sites layer (Points) depicts the collected assets located in Germany that are are connected to coal mining sites, aligning with the objectives of the CoalHeritage project. Specifically, this shapefile contains 15 spatial entities including an attribute table that follows the same structure as the aforementioned FR_sites layer. Indicatively, the attributes of GER_sites are: OBJECTIVEID, Shape, ID, Name, Latitude (DD), Longitude (DD), Active period, Mine Status, Mining Activity, Available Facilities, Type, and the Country (Table 3.2 & Figure 3.4).

Table 3.2 Descriptive table of shapefiles from the "Germany" feature dataset.

Feature	Geometry Type	Number of Entities	Fields (type)
GER_sites	Point	15	Active_period (Text), Mine_Status (Text), Mining_activity (Text), Available_Facilities (Text), Type (Text), Country (Text)

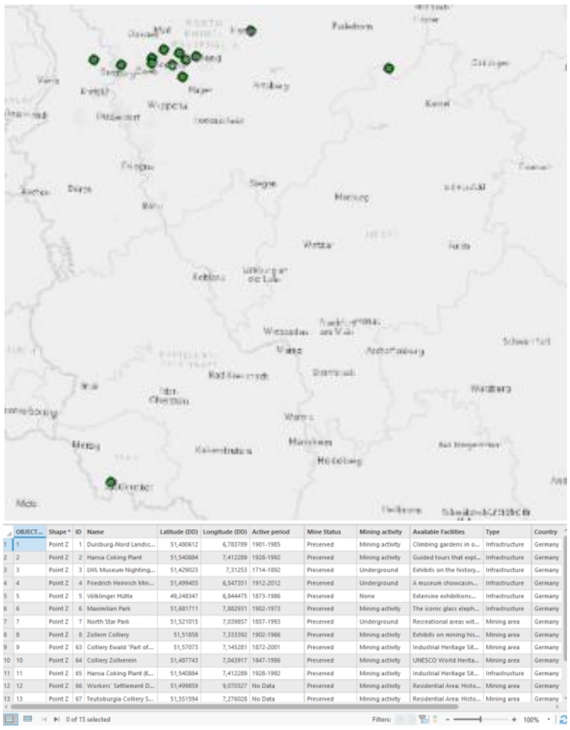


Figure 3.4 Visualization of the vector layer GER_sites within the ArcGIS environment, from the feature dataset "Germany".

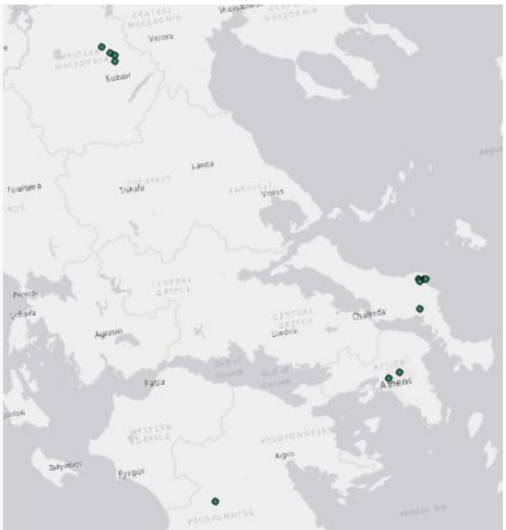
III. Greece

The third feature dataset called "Greece" and contains 2 features connected with the coal mine activity in Greece.

The first feature layer named GR_sites (Points) (Table 3.3 & Figure 3.5), illustrates all the recorded locations of sites that related with the coal mines in Greece. Specifically, these sites are spatial entities that depicting the location of infrastructures, machines and mining areas that are still operating, preserved or are abandoned. this layer consists of 24 spatial entities and following the same structure as the FR_sites. In particular, the attributes of GR_sites are: OBJECTIVEID, Shape, ID, Name, Latitude (DD), Longitude (DD), Active period, Mine Status, Mining Activity, Available Facilities, Type, and the Country.

Table 3.3 Descriptive table of shapefiles from the "Greece" feature dataset.

Feature	Geometry Type	Number of Entities	Fields (type)
GR_sites	Point	24	Active_period (Text), Mine_Status (Text), Mining_activity (Text), Available_Facilities (Text), Type (Text), Country (Text)
GR_mine_CLC20218	Polygon	4	OBJECTID (Object ID), Shape (Geometry), Shape_Length (Double), Shape_Area (Double), Mine (Text)



	OBJ...	Shape *	ID	Name	Latitude (...	Longitud...	Active period	Mine Status	Mining activity	Available Facilities	Type	Country
1	1	Point Z	30	School o...	40,413005	21,782004	No Data	No Data	No Data	No Data	No Data	Greece
2	2	Point Z	31	West Ma...	40,473125	21,74883	No Data	No Data	No Data	No Data	No Data	Greece
3	3	Point Z	32	Memorial...	40,523391	21,682978	No Data	No Data	No Data	No Data	No Data	Greece
4	4	Point Z	79	Prinias fa...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
5	5	Point Z	80	Kazarma...	38,631056	24,068111	No Data	No Data	No Data	No Data	Infrastructure	Greece
6	6	Point Z	81	LIPTOL li...	40,457778	21,785389	No Data	No Data	No Data	No Data	Infrastructure	Greece
7	7	Point Z	82	Air separ...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
8	8	Point Z	83	Wagon li...	38,433917	24,033417	No Data	No Data	No Data	No Data	No Data	Greece
9	9	Point Z	84	Vibrating...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
10	10	Point Z	85	Mine hoi...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
11	11	Point Z	86	Air ham...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
12	12	Point Z	87	Machine...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece
13	13	Point Z	88	Hydraulic...	38,433917	24,033417	No Data	No Data	No Data	No Data	Infrastructure	Greece

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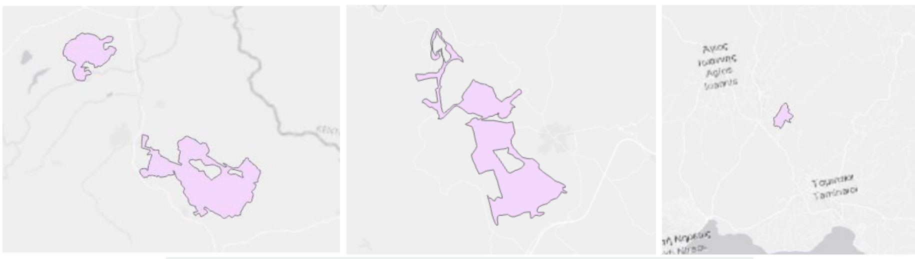
Figure 3.5 Visualization of the vector layer GR_sites within the ArcGIS environment, from the feature dataset "Greece".

The second feature layer titled as "GR_mines_CLC2018" (Polygons) (Table 3.3 & Figure 3.6) representing the boundaries of the Land Cover / Land Uses in wider area of Greece that are related to coal mine activity according to the Corine Land Cove (CLC) 2018. Specifically, this layer contains 4 spatial entities that have been extracted from the CLC 2018, which are categorized as mineral extraction sites or industrial areas and are intersected with the features of the GR_sites layer. Under this light, this product illustrates the wider boundaries of the coal mine areas in Greece as they depicted in the CLC 2018. In particular, this product has the default attributes FID (unique number), Shape_lenght, Shape_area, as well as a descriptive attribute title as Mine that contains the name of each area.



	FID *	Shape *	Shape_Length	Shape_Area	Mine
1	1	Polygon	2880,601059	313904,63535	Aliveri
2	2	Polygon	64000,502572	19319934,749449	Megalopoli
3	3	Polygon	88947,488707	81566438,649601	Ptolemaida
4	6	Polygon	32453,726571	25442827,996849	Amyntaio

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Figure 3.6 Visualization of the vector layer GR_mine_CLC20218 within the ArcGIS environment, from the feature dataset "Greece".

IV. Poland

The fourth feature dataset titled as “Poland” contains a single feature focused on sites associated with coal mining heritage. Like the other layers, the PL_sites layer (Points) represents the locations of infrastructures, machines, and landmarks associated with coal mining (Table 3.4 & Figure 3.7). This layer's attribute table follows the same structure as the other datasets, including OBJECTIVEID, Shape, ID, Name, Latitude (DD), Longitude (DD), Active period, Mine Status, Mining Activity, Available Facilities, Type, and Country. The specific number of spatial entities for the Poland dataset will be detailed in the following sections.

Table 3.4 Descriptive table of shapefiles from the “Poland” feature dataset.

Feature	Geometry Type	Number of Entities	Fields (type)
PL_sites	Points	27	Active_period (Text), Mine_Status (Text), Mining_activity (Text), Available_Facilities (Text), Type (Text), Country (Text)

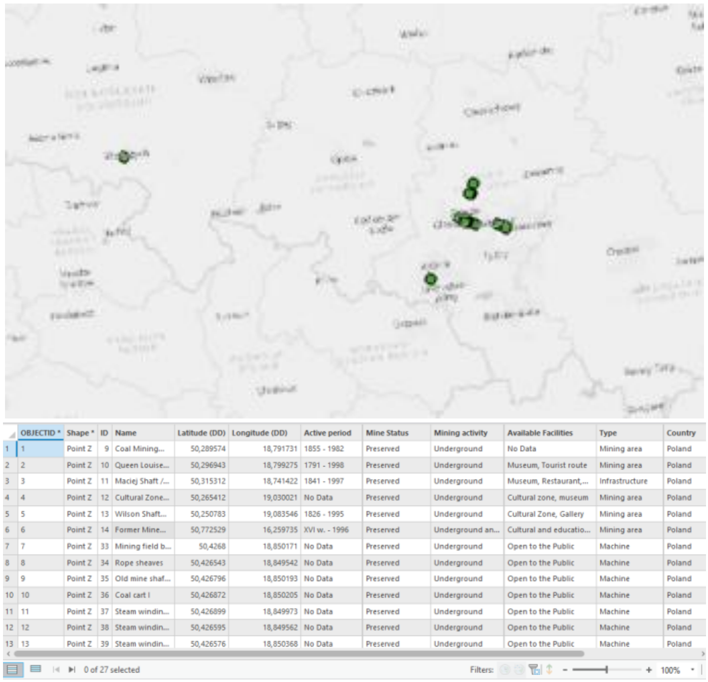


Figure 3.7 Visualization of the vector layer PL_sites within the ArcGIS environment, from the feature dataset “Poland”.

V. Slovenia

The fifth feature dataset called “Slovenia” contains 11 features connected with the coal mine activity in Slovenia.

The PV_mine_map layers (Polylines) (2015 to 2024) (Figure 3.8 to 3.17) focusing on the mining infrastructures (above and under the surface) in the Šalek Valley, each of them containing a number of entities (Table 3.5) based on the extraction of AutoCAD models provided by PV partners. Specifically, the attribute table of each feature includes information about the elevation in meters (Elevation), the recorded year (Year), and relative information about the entity (Layer). Additionally, the features are also having the default attributers regarding a unique number (OBJECTID), the type of geometry (Shape), as well as their length in meters (Shape_lenght). Each of these layers consists of up to 13,000 spatial entities. However, in the main geodatabase, they are treated as a single entity for each year, as they represent one main entity divided to collect elevation information.

Table 3.5 Descriptive table of shapefiles from the "Slovenia" feature dataset.

Feature	Geometry Type	Number of Entities	Year	Fields (type)
PV_mine_map_2015	Polyline Z	13.132	2015	OBJECTID (Object ID), Shape (Geometry), Layer (Text), Elevation (Double), Year (Text), Shape_lenght (Double)
PV_mine_map_2016	Polyline Z	12.197	2016	
PV_mine_map_2017	Polyline Z	12.289	2017	
PV_mine_map_2018	Polyline Z	12.814	2018	
PV_mine_map_2019	Polyline Z	13.051	2019	
PV_mine_map_2020	Polyline Z	13.461	2020	
PV_mine_map_2021	Polyline Z	13.424	2021	
PV_mine_map_2022	Polyline Z	13.515	2022	
PV_mine_map_2023	Polyline Z	12.924	2023	
PV_mine_map_2024	Polyline Z	12.129	2024	
PL_sites	Point	21	-	Active_period (Text), Mine_Status (Text), Mining_activity (Text), Available_Facilities (Text), Type (Text), Country (Text)

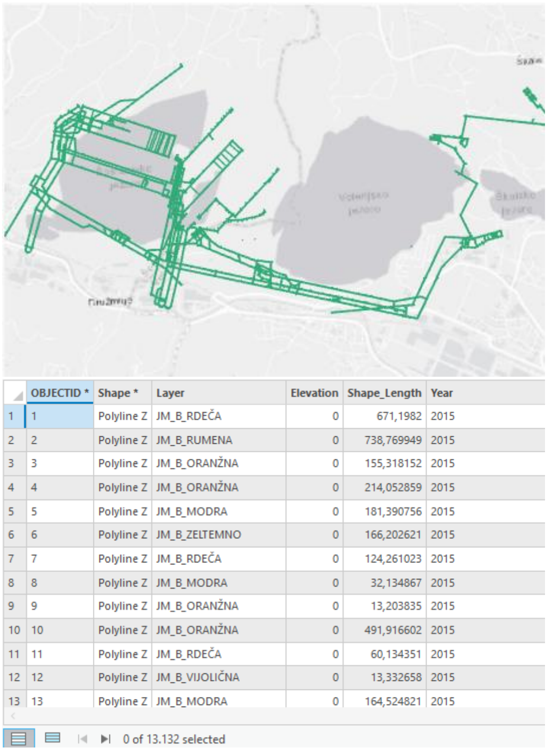


Figure 3.8 Visualization of the vector layer PV_mine_map_2015 within the ArcGIS environment, from the feature dataset "Slovenia".

	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_OSI	-109,962	272,25047	2016
2	2	Polyline Z	JM_BOKI	-109,137043	30,756312	2016
3	3	Polyline Z	JM_BOKI	-108,922	10,862405	2016
4	4	Polyline Z	JM_BOKI	-108,590836	25,111354	2016
5	5	Polyline Z	JM_BOKI	-109,114208	27,490268	2016
6	6	Polyline Z	JM_BOKI	-108,922	11,581379	2016
7	7	Polyline Z	JM_BOKI	-108,510427	21,837931	2016
8	8	Polyline Z	JM_ODKOPI	0	696,445408	2016
9	9	Polyline Z	JM_OBZPROGE	-132,199	1,673491	2016
10	10	Polyline Z	JM_OBZPROGE	183,631483	3,000687	2016
11	11	Polyline Z	JM_OBZPROGE	-42,641	1,449495	2016
12	12	Polyline Z	JM_OBZPROGE	167,933825	3,000546	2016
13	13	Polyline Z	JM_OBZPROGE	185,328319	5,000453	2016

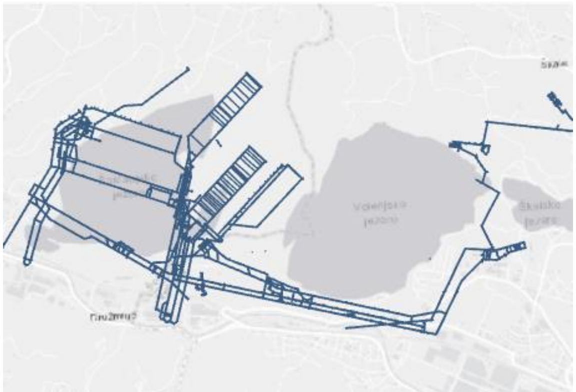
0 of 12.197 selected

Figure 3.9 Visualization of the vector layer PV_mine_map_2016 within the ArcGIS environment, from the feature dataset "Slovenia".

	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_B_RDEČA	0	161,298238	2017
2	2	Polyline Z	JM_B_RDEČA	0	42,985806	2017
3	3	Polyline Z	JM_B_RDEČA	0	36,060129	2017
4	4	Polyline Z	JM_B_ORANŽNA	0	355,14692	2017
5	5	Polyline Z	JM_ODKOPI	0	499,345955	2017
6	6	Polyline Z	JM_ODKOPI	0	462,116357	2017
7	7	Polyline Z	JM_B_MODRA	31,269	84,398596	2017
8	8	Polyline Z	JM_OBZPROGE	-132,199	1,673491	2017
9	9	Polyline Z	JM_OBZPROGE	183,631483	3,000687	2017
10	10	Polyline Z	JM_OBZPROGE	-42,641	1,449495	2017
11	11	Polyline Z	JM_OBZPROGE	167,933825	3,000546	2017
12	12	Polyline Z	JM_OBZPROGE	185,328319	5,000453	2017
13	13	Polyline Z	JM_JAŠKI	0	16,656692	2017

0 of 12.289 selected

Figure 3.10 Visualization of the vector layer PV_mine_map_2017 within the ArcGIS environment, from the feature dataset "Slovenia".



	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_B_RUMENA	0	12,530912	2018
2	2	Polyline Z	JM_B_RDEČA	0	161,298238	2018
3	3	Polyline Z	JM_B_RDEČA	0	42,985806	2018
4	4	Polyline Z	JM_B_RDEČA	0	36,060129	2018
5	5	Polyline Z	JM_B_ORANŽNA	0	355,14692	2018
6	6	Polyline Z	JM_B_MODRA	31,269	84,398596	2018
7	7	Polyline Z	JM_OBZPROGE	-132,199	1,673491	2018
8	8	Polyline Z	JM_OBZPROGE	183,631483	3,000687	2018
9	9	Polyline Z	JM_OBZPROGE	-42,641	1,449495	2018
10	10	Polyline Z	JM_OBZPROGE	167,933825	3,000546	2018
11	11	Polyline Z	JM_OBZPROGE	185,328319	5,000453	2018
12	12	Polyline Z	JM_JAŠKI	0	16,656692	2018
13	13	Polyline Z	JM_B_RDTEMNO	0	20,2502	2018

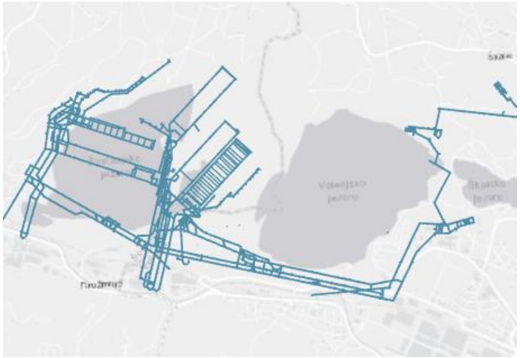
0 of 12.814 selected

Figure 3.11 Visualization of the vector layer PV_mine_map_2018 within the ArcGIS environment, from the feature dataset "Slovenia".

	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_B_RDEČA	0	222,965888	2019
2	2	Polyline Z	JM_ODKOPI	0	373,645325	2019
3	3	Polyline Z	JM_ODKOPI	3,118545	386,246587	2019
4	4	Polyline Z	JM_B_RUMENA	0	13,728604	2019
5	5	Polyline Z	JM_B_RDEČA	0	42,985806	2019
6	6	Polyline Z	JM_B_MODRA	31,269	84,398596	2019
7	7	Polyline Z	JM_OBZPROGE	-132,199	1,673491	2019
8	8	Polyline Z	JM_OBZPROGE	183,631483	3,000687	2019
9	9	Polyline Z	JM_OBZPROGE	-42,641	1,449495	2019
10	10	Polyline Z	JM_OBZPROGE	167,933825	3,000546	2019
11	11	Polyline Z	JM_OBZPROGE	185,328319	5,000453	2019
12	12	Polyline Z	JM_JAŠKI	0	16,656692	2019
13	13	Polyline Z	JM_B_RDTEMNO	0	20,2502	2019

0 of 13.051 selected

Figure 3.12 Visualization of the vector layer PV_mine_map_2019 within the ArcGIS environment, from the feature dataset "Slovenia".



	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_OBZPROGE	-120,537	36,901564	2020
2	2	Polyline Z	JM_OBZPROGE	-120,561	14,18998	2020
3	3	Polyline Z	JM_OBZPROGE	-120,546439	24,315705	2020
4	4	Polyline Z	JM_OBZPROGE	-120,567416	0,999992	2020
5	5	Polyline Z	JM_OBZPROGE	-120,56735	6,000473	2020
6	6	Polyline Z	JM_OBZPROGE	-120,581894	1,00072	2020
7	7	Polyline Z	JM_OBZPROGE	-120,58196	3,773025	2020
8	8	Polyline Z	JM_OBZPROGE	-120,591935	2,465067	2020
9	9	Polyline Z	JM_ODKOPI	-6,232977	783,911894	2020
10	10	Polyline Z	JM_B_RDEČA	0	222,965888	2020
11	11	Polyline Z	JM_B_RUMENA	0	13,728604	2020
12	12	Polyline Z	JM_B_RDEČA	0	42,985806	2020
13	13	Polyline Z	JM_B_MODRA	31,269	84,398596	2020

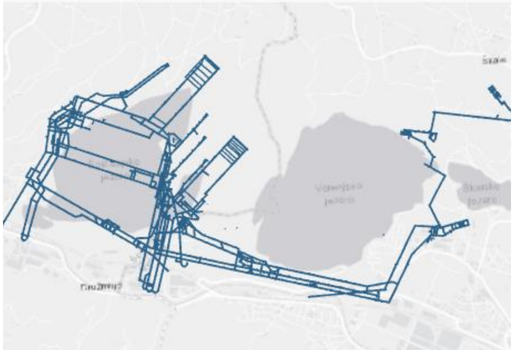
0 of 13.461 selected

Figure 3.13 Visualization of the vector layer PV_mine_map_2020 within the ArcGIS environment, from the feature dataset "Slovenia".

	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_ODKOPI	110,291784	456,485491	2021
2	2	Polyline Z	JM_B_RDEČA	0	13,585084	2021
3	3	Polyline Z	JM_B_MODRA	0	56,943338	2021
4	4	Polyline Z	JM_B_RDTEMNO	0	20,2502	2021
5	5	Polyline Z	JM_B_RDTEMNO	0	26,16474	2021
6	6	Polyline Z	JM_B_RDTEMNO	0	23,103148	2021
7	7	Polyline Z	JM_B_RDTEMNO	0	121,248158	2021
8	8	Polyline Z	JM_B_RDTEMNO	0	181,791849	2021
9	9	Polyline Z	JM_B_RDTEMNO	0	142,548201	2021
10	10	Polyline Z	JM_B_RDTEMNO	0	102,829347	2021
11	11	Polyline Z	JM_B_RDTEMNO	0	17,320898	2021
12	12	Polyline Z	JM_B_RDTEMNO	0	9,636599	2021
13	13	Polyline Z	JM_B_RDTEMNO	0	108,49793	2021

0 of 13.424 selected

Figure 3.14 Visualization of the vector layer PV_mine_map_2021 within the ArcGIS environment, from the feature dataset "Slovenia".



	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_ODKOPI	4,315539	566,45126	2022
2	2	Polyline Z	JM_ODKOPI	4,315539	483,183071	2022
3	3	Polyline Z	JM_B_MODRA	0	84,043498	2022
4	4	Polyline Z	JM_B_MODRA	0	56,943338	2022
5	5	Polyline Z	JM_B_RDTEMNO	0	20,2502	2022
6	6	Polyline Z	JM_B_RDTEMNO	0	26,16474	2022
7	7	Polyline Z	JM_B_RDTEMNO	0	23,103148	2022
8	8	Polyline Z	JM_B_RDTEMNO	0	121,248158	2022
9	9	Polyline Z	JM_B_RDTEMNO	0	181,791849	2022
10	10	Polyline Z	JM_B_RDTEMNO	0	142,548201	2022
11	11	Polyline Z	JM_B_RDTEMNO	0	102,829347	2022
12	12	Polyline Z	JM_B_RDTEMNO	0	17,320898	2022
13	13	Polyline Z	JM_B_RDTEMNO	0	9,636599	2022

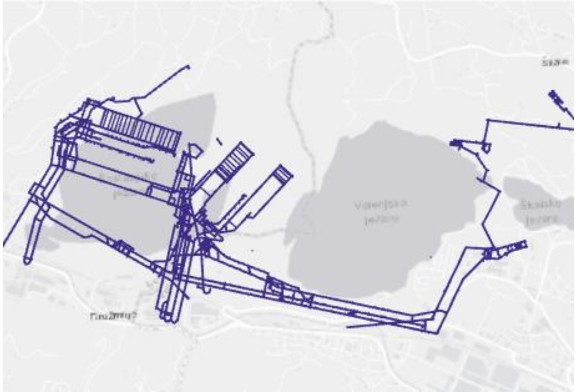
0 of 13.515 selected

Figure 3.15 Visualization of the vector layer PV_mine_map_2022 within the ArcGIS environment, from the feature dataset "Slovenia".

	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_ODKOPI	-1,229297	414,161486	2023
2	2	Polyline Z	JM_B_RDEČA	0	211,414925	2023
3	3	Polyline Z	JM_B_MODRA	0	56,943338	2023
4	4	Polyline Z	JM_B_RDTEMNO	0	20,2502	2023
5	5	Polyline Z	JM_B_RDTEMNO	0	26,16474	2023
6	6	Polyline Z	JM_B_RDTEMNO	0	23,103148	2023
7	7	Polyline Z	JM_B_RDTEMNO	0	121,248158	2023
8	8	Polyline Z	JM_B_RDTEMNO	0	181,791849	2023
9	9	Polyline Z	JM_B_RDTEMNO	0	142,548201	2023
10	10	Polyline Z	JM_B_RDTEMNO	0	102,829347	2023
11	11	Polyline Z	JM_B_RDTEMNO	0	17,320898	2023
12	12	Polyline Z	JM_B_RDTEMNO	0	9,636599	2023
13	13	Polyline Z	JM_B_RDTEMNO	0	108,49793	2023

0 of 12.924 selected

Figure 3.16 Visualization of the vector layer PV_mine_map_2023 within the ArcGIS environment, from the feature dataset "Slovenia".



	OBJECTID *	Shape *	Layer	Elevation	Shape_Length	Year
1	1	Polyline Z	JM_ODKOPI	0	351,326113	2024
2	2	Polyline Z	JM_ODKOPI	0,181791	394,113789	2024
3	3	Polyline Z	JM_ODKOPI	0	400,373642	2024
4	4	Polyline Z	JM_B_MODRA	0	56,942893	2024
5	5	Polyline Z	JM_B_RDTEMNO	0	20,2502	2024
6	6	Polyline Z	JM_B_RDTEMNO	0	26,165018	2024
7	7	Polyline Z	JM_B_RDTEMNO	0	23,102993	2024
8	8	Polyline Z	JM_B_RDTEMNO	0	121,248396	2024
9	9	Polyline Z	JM_B_RDTEMNO	0	181,791715	2024
10	10	Polyline Z	JM_B_RDTEMNO	0	142,54808	2024
11	11	Polyline Z	JM_B_RDTEMNO	0	102,829713	2024
12	12	Polyline Z	JM_B_RDTEMNO	0	17,320513	2024
13	13	Polyline Z	JM_B_RDTEMNO	0	9,63631	2024

1 of 12.129 selected

Figure 3.17 Visualization of the vector layer PV_mine_map_2024 within the ArcGIS environment, from the feature dataset "Slovenia".

The second feature layer of Slovenia feature dataset, is title as SL_sites (Points) and contains all the recorded sites that are related to coal mine heritage in wider area of Slovenia (Fig. 3.18). In particular, the most of the presented sites in this layer are consecrated in Šalek Valley and are highlighting the location of infrastructures, machines and landmarks that are connected with the mining activity. Specifically, this layer has 21 spatial entities and follows the same structure as the aforementioned layers in the other feature datasets (e.g., FR_sites, GER_sites, e.t.c). In particular, the attributes of SL_sites are: OBJECTIVEID, Shape, ID, Name, Latitude (DD), Longitude (DD), Active period, Mine Status, Mining Activity, Available Facilities, Type, and the Country.

	OBJECTID *	Shape *	ID	Name	Latitude (DD)	Longitude (DD)	Active peri...	Mine Status	Mining activity	Available F...	Type	Country
1	1	Point Z	18	Coal Mining Mus...	46,37255	15,099182	1999-	Operating	Underground	No Data	Mining area	Slovenia
2	2	Point Z	19	The Zagorje Mini...	46,140421	14,968871	1995-	Operating	Underground	No Data	Mining area	Slovenia
3	3	Point Z	20	The City of velenje	46,359641	15,115221	1959-	Operating	None	No Data	Infrastructure	Slovenia
4	4	Point Z	21	Pesje Coal chrush...	46,368949	15,077727	1972-2003	Preserved	Surface Mining	No Data	Mining area	Slovenia
5	5	Point Z	22	The Velenje Railw...	46,363433	15,104756	1891-	Operating	None	No Data	Infrastructure	Slovenia
6	6	Point Z	23	The Škale shaft -...	46,372541	15,098576	1888-	Operating	Underground and Sur...	No Data	Mining area	Slovenia
7	7	Point Z	24	The Velenje Powe...	46,371296	15,099122	1928-1971	Preserved	Surface Mining	No Data	Infrastructure	Slovenia
8	8	Point Z	25	Miners' changing...	46,37255	15,099182	1888-	Operating	Surface Mining	No Data	Infrastructure	Slovenia
9	9	Point Z	26	The Dimonion Mi...	46,372014	15,098082	1954-1989	Preserved	Underground and Sur...	No Data	Machine	Slovenia
10	10	Point Z	27	The GPK Roadhe...	46,372005	15,09768	No Data	Operating	Underground	No Data	Machine	Slovenia
11	11	Point Z	28	The AKU locomot...	46,372327	15,099478	No Data	Operating	Underground and Sur...	No Data	Machine	Slovenia
12	12	Point Z	29	Premogovnik Vel...	46,371948	15,069105	No Data	No Data	Underground	No Data	Mining area	Slovenia
13	13	Point Z	70	The Dominion Mi...	46,372526	15,098582	No Data	No Data	No Data	No Data	No Data	Slovenia

0 of 21 selected

Figure 3.18 Visualization of the vector layer SL_sites within the ArcGIS environment, from the feature dataset "Slovenia".

VI. Integration into the European Geological Data Infrastructure (EGDI)

As part of the CoalHeritage project, the geospatial data from the feature datasets described in the previous sub-sections have been integrated into the European Geological Data Infrastructure (EGDI) (Fig 3.19). This integration process involved merging all the aforementioned point data from the individual country datasets (France, Germany, Greece, Poland, and Slovenia) into a single shapefile that follows the EGDI's standardized data structure. The integration of these geospatial datasets into the EGDI brings several key benefits. In particular, the EGDI platform allows for easier access to coal mining heritage data by a wider audience, including researchers, policymakers, and the general public. Furthermore, by following EGDI's standards, the dataset is now interoperable with other geological datasets across Europe, enabling cross-disciplinary research and analysis. Additionally, the standardization process ensures that data from different countries can be compared and analyzed on a common platform, promoting consistency. Lastly, this integration ensures the preserving and the accessibility of the coal mining heritage of Europe, ensuring that these valuable datasets contribute to the broader European geological knowledge base.

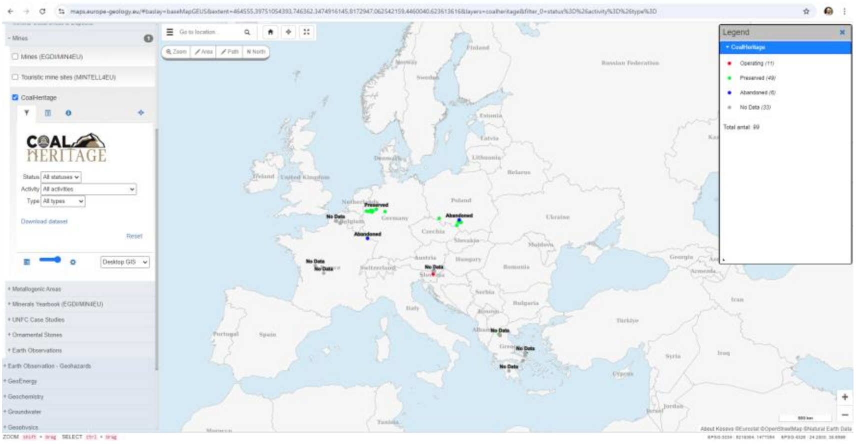


Figure 3.19 Screenshot of the integrated geodatabase into the EGDI platform.

EGDI Data Structure and Harmonization Process

The EGDI provides a pan-European platform for geological data, ensuring consistency and interoperability across national datasets. To align with this, the integration process required the harmonization of attributes across the different country datasets. Specifically, the following steps were undertaken:

Each country's point data, originally structured with attributes such as Name, Latitude, Longitude, Period, Status, Activity, Facilities, Type, and Country, was reviewed and adjusted where necessary to match the EGDI's attribute schema (Fig 3.20). This involved ensuring consistent attribute naming conventions and data formats. Furthermore, there is an additional column that contains a link that transfers the users to the CoalHeritage website.

CoalHeritage

Go to	Name	Latitude	Longitude	Period	Status	Activity
	LWL Museum Nightingale Colliery	51.429023	7.31253	1714-1892	Preserved	Underground
	Friedrich Heinrich Mine Park	51.499403	6.547351	1912-2012	Preserved	Underground
	North Star Park	51.521015	7.039857	1857-1993	Preserved	Underground
	Coal Mining Museum in Zabrze	50.289574	18.791731	1855 - 1982	Preserved	Underground
	Queen Louise Adit	50.296943	18.799275	1791 - 1998	Preserved	Underground
	Maciej Shaft /Zabrze	50.315312	18.741422	1841 - 1997	Preserved	Underground
	Cultural Zone in Katowice	50.265412	19.030021	No Data	Preserved	Underground
	Wilson Shaft Gallery	50.250783	19.083546	1826 - 1995	Preserved	Underground

Facilities	Type	Country	
Exhibits on the history of coal mining and the industrial revolution. Guided tours of the mine and its equipment. Demonstrations of mining techniques. Educational programs and workshops. Event spaces for cultural activities.	Infrastructure	Germany	Link...
A museum showcasing mining history and equipment. Recreational areas with walking and biking trails. Event spaces for cultural and community events. Art installations and sculptures. Information centers and guided tours.	Infrastructure	Germany	Link...
Recreational areas with playgrounds, walking, and cycling paths. The landmark Nordstern Tower, which offers panoramic views and hosts exhibitions. Amphitheater for concerts and performances. Sculptures and art installations. Event spaces for community ev	Mining area	Germany	Link...
No Data	Mining area	Poland	Link...
Museum, Tourist route	Mining area	Poland	Link...
Museum, Restaurant, cultural Zone	Infrastructure	Poland	Link...
Cultural zone, museum	Mining area	Poland	Link...
Cultural Zone, Gallery	Mining area	Poland	Link...

Figure 3.20 Screenshot of the integrated geodatabase into the EGDI platform.

The harmonized datasets were then merged into a single shapefile. The unified shapefile contains the spatial entities from all five countries, providing a comprehensive overview of coal mining heritage sites across the project area. The merged shapefile was further validated to ensure full alignment with EGDI standards, including checks for data format (Geopackage), completeness, and consistency with the spatial reference system (WGS 1984 EPSG:4326 - WGS 84). This step was crucial in guaranteeing that the integrated dataset could be seamlessly incorporated into the EGDI platform, facilitating broader accessibility and use.

VII. Validation of the methodology

The potential of using GIS technology will be illustrated through innovative and friendly-user storytelling maps providing such elements as interactive maps, visual appeal and strong sense of coal heritage places. This process includes collecting data on physical objects, archival documents, photographs and any other elements related to the history and operation of the mine. In turn, management of mine resources as cultural heritage is an approach that includes planning, protection, promotion and sustainable use of these resources (UNDP, 2018).

The GIG-PIB research aims to validate methodology of a geodatabase for selected coal mines. This step is very important for the integration of the data in the web GIS application for the creation of the visual map in next task. Analysis of the methodology was expert assessments containing two methods:

- CAWI In-Depth Interview (CAWI-IDI),
- Focus Group Interview (FGI).

Questions concerning validation of the methodology of a geodatabase for coal mines were an integral part of the survey tools linked to Task 3.2 survey (FGI, IDI).

a) General assumptions of the methodology as an assessment tools

Focus Group Interview FGI

FGI is a research method used in social sciences. It is a form of group discussion involving a small number of people representing the target research group, usually 6 to 12. This method explores participants' opinions, attitudes, feelings and reactions on a specific topic. The characteristic features of a focused group interview (FOCUS) are:

- focus on the research topic,
- moderation,
- interaction between participants,

- analysis of group dynamics,
- openness to diversity,
- complementary techniques. (Morgan&Hoffman 2010).

In-Depth Interview (IDI)
IDI is a research method in which the researcher conducts in-depth interviews with experts in a given field. It could be run in-person or online, in the form of CAWI (Computer Assisted Web Interview) technique. This type of interview focuses on obtaining detailed information from one respondent who has specialized knowledge about a given study. Expert of In-depth Interview (IDI) has:
- specialized knowledge, experience or expertise in a specific field,
- developing the topic,
- elaboration of answers,
- individual context,
- no group influence. Unlike group discussion (FOCUS), IDI lacks the influence of dynamic group interactions, which allows for more individual and undistorted responses (Boyce&Neale 2006).

Survey experts
The selection of participants (experts) in the FOCUS and CAWI IDI research on the topic of inventory and management of mine resources as cultural heritage was thoroughly discussed in the GIG-PIB research team and takes into account specific aspects of this research area. In particular, research participants have professional knowledge, show interest and activity in the protection of cultural heritage and are committed and sensitive to topics related to cultural heritage related to mines. GIG-PIB experts ensured their knowledge and experience related to the field of cultural heritage, and conservation of monuments, are representatives of institutions dealing with heritage, in particular related to mining, represent mining companies, mining engineering staff, are people who manage activities related to the extraction of raw materials, they can provide practical information regarding the management of mine resources. Equally important experts were:
- representatives of industrial heritage organizations at different levels,
- representatives associated with regional authorities,
- representatives of local mining communities
- representatives of other organizations dealing with the protection of cultural heritage and the mining environment.

The principle of gender and age balance is maintained in the selection of experts, which allows for obtaining diverse perspectives and experiences in research.

Research tools construction
The research tools were:
1. CAWI IDI Questionnaire, for online dissemination. CAWI IDI questionnaire form, as well as achieved CAWI IDI questionnaire are attached to this Deliverable. The tool was designed using a combination of single-choice, multiple choice and open-ended questions to capture both quantitative and qualitative data.

2. The FGI Scenario, focuses on the essential aspects of the inventory processes and managing the mine's movable and immovable property. FGI Scenario is an appendix to this Deliverable.

Both research tools have been discussed and revised by all Coal Heritage project partners.

A Focus Group Interview has been held in 2 groups of at least 6 experts.

International FGI

21.05.2024 – FGI with international experts, online. The meeting gathered 7 outstanding international experts in the field of industrial heritage:

1. Miles Oglethrope, presidents of The International Committee for the Conservation of the Industrial Heritage TICCIH (UK),
2. Catharine Bertram (Peril Bassin Minier Nord Pas de Calais, FR),
3. Jaap Nieweg (European Federation of Museums and Tourist Railways FEDECRAIL, NL),
4. Vasilios Melfos (Aristotle University of Thessaloniki GR),
5. Piotr Gerber (President of the International Committee For The Conservation of The Industrial Heritage TICCIH Polska, PL),
6. Ewa Wojtoń (Coal Mining Museum in Zabrze, PL),
7. Ross Forbes (Durham Miners Association, UK).

Hildebrand de Boer (The Industrial and Engineering Heritage Committee, NL) couldn't attend the FGI but he has sent his FGI scenario response. It has been included in the analysis.

FGI was moderated by Sylwia Jarosławska-Sobór and Piotr Hetmańczyk. Robert Hildebrandt, the Coal Heritage project manager in GIG-PIB, welcomed guests and gave information about the project and financing from RFCS.

The discussion aimed to obtain knowledge on the participants' perspectives and experiences related to the inventory and management of mine resources as cultural heritage. Additionally, to obtain experts' assessment on methodology to geodatabase for selected coal heritage sites.

Regional FGI

24.05.2024 – regional with regional expert, on the premises of GIG-PIB, Katowice. The meeting gathered 7 outstanding Polish experts in the field of mining and industrial heritage:

- Beata Piecha-van Schagen (Department Manager, Muzeum Górnośląski Park Etnograficzny in Chorzów),
  Bartłomiej Szewczyk (Director, Muzeum Górnictwa Węglowego in Zabrze),
- Marek Gołosz (director of the Ignacy mine in Rybnik),
- Łukasz Konarzewski (Provincial Conservator of Monuments in Silesia)
- Piotr Rygus (Department Manager, Muzum Śląskie in Katowice),
- Adrianna Kordiak-Woryna (director of SGGP),
- Ewa Caban (Manager, Centrum Dziedzictwa Kulturowego Instytut Korfantego in Katowice),
- Adam Rostecki (Mobilne Centrum Digitalizacji Instytut Korfantego in Katowice).

FGI was moderated by Ryszard Marszowski. Robert Hildebrandt, the Coal Heritage project manager in GIG-PIB, welcomed guests and gave information about the project and financing from RFCS.

The discussion aimed to obtain knowledge on the participants' perspectives and experiences related to the inventory and management of mine resources as cultural heritage. Moreover, to obtain experts' assessment on methodology to geodatabase for selected coal heritage sites.

Data Analysis and Discussion of Results

Geodatabase for coal heritage sites in the context of methodology validation refers to the systematic process of collecting, Data Analysis and Discussion of Results

i. *Experts views of geodatabase for coal heritage sites*

In one of the open question experts have been asked to express their general opinion on localization of cultural heritage related to mining. The experts' answers were extensive and are included in the survey questionnaires that are attached to Deliverable. Below some selected statements are presented and an analysis of the whole question. Below is a summary of insights provided by experts, based on selected statements regarding the coal heritage geodatabase, with the statements available in the Appendix.

Summary of the experts' answers to geodatabase of coal mines in the context of cultural heritage:

Mines, in the context of cultural heritage, are indeed unique in terms of the challenges and opportunities they present. Unique challenges are

- modern technologies and data management, accurate and comprehensive inventory often require the use of advanced technologies like 3D scanning, GIS and drones. Managing the large amounts of data collected during the inventory requires efficient database systems and appropriate IT infrastructure. These technologies are costly and require specialized expertise,
- large and diverse mining sites often encompass extensive and varied areas, including underground galleries, above-ground facilities, machinery, tools, and associated infrastructure. Fully documenting these elements can be time-consuming and requires specialized knowledge in history, archaeology, geology, and engineering. Also, historical cataloguing of mining activities may be incomplete or scattered, adding complexity to the task of cataloging mining heritage accurately.

ii. ***Inventory of Mine Assets***

Within the area of using inventory of mine assets, useful for geodatabase, experts have been asked to specify elements of the mine assets that require special attention during the inventory process. It was a multiple-choice question. Experts indicated almost all categories of mine assets as important for inventorying due to their importance to cultural and historical heritage: historical mine buildings, historical mining machines and equipment, archival documents and mining maps, mining traditions and practices and mining memorials and monuments. As “other” they indicated also:

- stories of individuals to safeguard the memory of the workers and their families,
- representative parts of underground mine workings together with a presentation of technology and underground miner’s lives,
- coal mining areas can remain places of modern mining education (e.g. geotechnology, environment, waste materials management etc.),
- geological features and mineral species,
- mining infrastructure adits, shafts and tunnels.

One of the expert also points out the problem of environmental pollutants, such as groundwater or air contamination. Their inventory and monitoring are important for assessing the impact of mining on the environment and planning reclamation activities. It is also needed to ensure that personnel are adequately protected against potential hazards associated with mining sites, such as collapses or gas poisoning. Below is the summary of key insights regarding the geodatabase, based on selected expert statements, which can be found in the appendix.

Summary of the experts' answers to the inventory of mine assets

All experts confirmed that there is no single model of inventory of mine assets. In each case, the situation should be considered individually, depending on the state of resources, the situation of the region, but also on the social attitude. Experts indicated 4 categories of up-to-date inventory methods that they consider most effective:

- laser scanning for precise measurement of land topography,
- drone technologies to obtain images and data from difficult-to-reach areas,
- virtual reality for creating interactive visualizations of mining areas,
- IT systems for collecting and sharing inventory data.

Moreover, experts underlined that in inventory of mine assets, including its geodatabase, important are:

- financial and resource constraints, the process of inventorying and managing mining heritage requires significant financial resources for research, documentation, maintenance, restoration, and safety measures. Limited funding often hampers these efforts,
- difficulty in identification, some mining sites are abandoned or damaged, making their identification and documentation challenging,
- large and diverse areas, mines often encompass extensive and varied areas, including underground galleries, above-ground facilities, machinery, tools, and associated infrastructure. Fully documenting these elements can be time-consuming and requires specialized knowledge in history, archaeology, geology, and engineering,
- state of preservation, many historic mines are in poor condition due to disuse, natural deterioration, and lack of maintenance. Rapid decay necessitates immediate protective measures to prevent further deterioration,
- modern technologies and data management, accurate and comprehensive inventory often require the use of advanced technologies like 3D scanning, GIS and drones. Managing the large amounts of data collected during the inventory requires efficient database systems and appropriate IT infrastructure. These technologies are costly and require specialized expertise.

4. DEVELOPMENT OF THE 3D MODELS GEODATABASE

The following section outlines the methodology for converting GLB (GL Transmission Format) files to be used in ArcGIS Pro and ArcGIS Online. It also provides a detailed description and specifications of the 3D items involved. This process enables the integration of 3D models into geographic information systems (GIS) for advanced spatial analysis and visualization.

Step 1: Preparing the GLB File

The first step involves preparing the GLB file to ensure it is suitable for conversion and integration. Begin by verifying the GLB file to confirm it is complete and not corrupted. Tools like GLTF Validator can be used to check the integrity of the file. Once the file is verified, it should be optimized for performance using tools such as gltf-pipeline, which can reduce the file size and improve loading times. Additionally, software like Blender can be used for further refinement and editing of the 3D model if necessary. In particular, 3D models are developed based on photos of real objects using the photogrammetry method. Photorealistic models created in this way, apart from their presentation on a visual map, can also be used as teaching aids in modern forms of education using multimedia presentation techniques or Extended Reality (XR) techniques. 3D models in GLB format were derived from KOMAG partner. Examples of developed 3D models are depicted in the fowling images (Fig. 4.1 & 4.2).

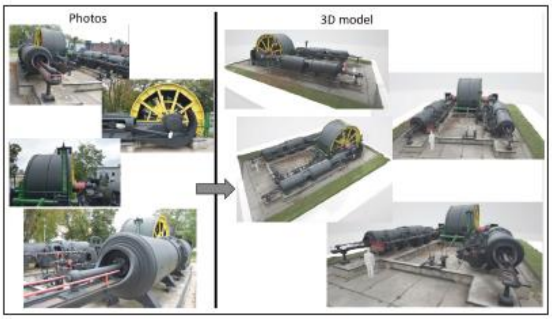


Figure 4.1 A steam hoisting machine-photos and a 3D model.

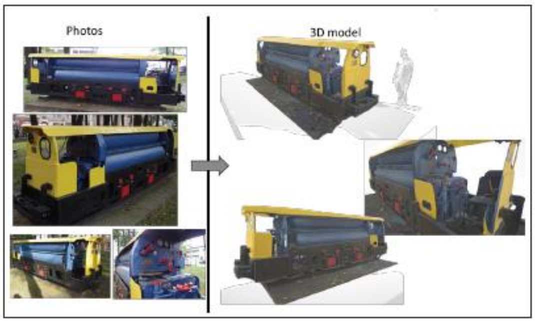


Figure 4.2 A locomotive-photos and a 3D model.

Step 2: Converting GLB to a Supported Format

ArcGIS Pro and ArcGIS Online support several 3D formats, including I3S, 3D Object Scene Layer (.slpk), and 3D Model Scene Layer. The recommended approach is to convert the GLB files to the Scene Layer Package (SLPK) format. This can be done using ArcGIS Pro's built-in tools. Open ArcGIS Pro and navigate to the 'Geoprocessing' pane. Use the 'Create 3D Object Scene Layer Package' tool, input the GLB file, and specify the desired output location and other parameters. Alternatively, third-party tools and scripts can be used for conversion if ArcGIS Pro is not available, ensuring the output is compatible with ArcGIS Pro and ArcGIS Online.

Step 3: Importing into ArcGIS Pro

Once the GLB file has been converted to the SLPK format, it can be imported into ArcGIS Pro. Open ArcGIS Pro and create a new project or use an existing one. Add a new scene by navigating to the 'Insert' tab and selecting 'New Scene'. Then, add the SLPK file to the scene by using the 'Add Data' button. This will import the 3D model into the scene, allowing it to be manipulated and analyzed within the GIS environment (Fig. 4.3).

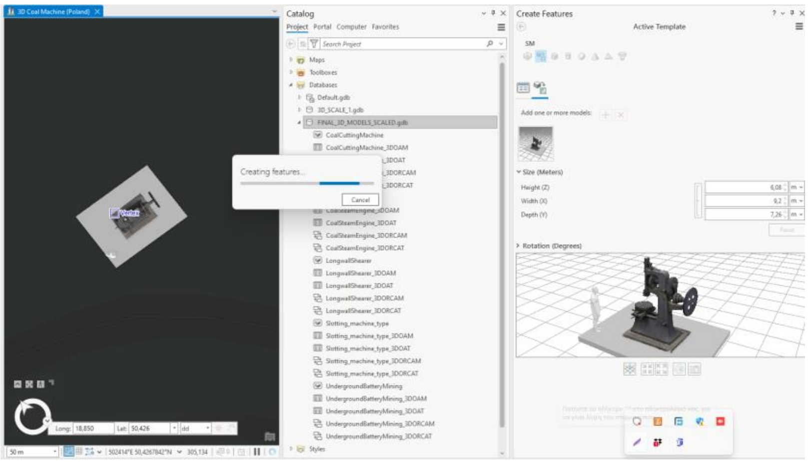


Figure 4.3 Publishing to ArcGIS Online.

To make the 3D model accessible online, it must be published to ArcGIS Online. In ArcGIS Pro, ensure the SLPK file is added to a scene or map. Sign in to your ArcGIS Online account and navigate to the 'Share' tab. Use the 'Share As Web Layer' tool to publish the 3D model. Select the appropriate layer type (e.g., Scene Layer), provide the necessary metadata, and configure the sharing settings. Once published, the 3D model will be available on ArcGIS Online for visualization and analysis.

Description and Specifications of 3D Items

The 3D items used in ArcGIS Pro and ArcGIS Online typically include various types of geographic features and models. These items can range from simple buildings and structures to complex urban landscapes and natural environments. Each 3D item is characterized by several specifications:

- **Geometry:** Defines the shape and structure of the 3D model. It includes vertices, edges, and faces that form the model's mesh.
- **Textures:** Provide surface details and color to the 3D model. Textures are often mapped onto the geometry to enhance realism.
- **Materials:** Define the appearance of the 3D model's surface, including properties such as color, reflectivity, and transparency.
- **Level of Detail (LOD):** Indicates the complexity of the 3D model at different scales. Higher LODs provide more detail but require more computational resources.
- **Metadata:** Includes information about the 3D model, such as its source, creator, date of creation, and any associated attributes or data.

By following this methodology, GLB files can be effectively converted and integrated into ArcGIS Pro and ArcGIS Online, enabling robust 3D spatial analysis and visualization within a GIS framework. This process ensures that 3D models are accurately represented and optimized for performance in both desktop and online environments.

Until now, four 3D models have been uploaded in EVMJ platform within the boundaries of Poland, where user can explore their dimensions in the real word. For instance, the 3D model of Frederick Hurda's first chain coal cutting machine (Figure xx) located in Poland, which was used widely in English and German mines in the 19th century is depicted at a real scale providing a realistic sense of size and space (Fig. 4.4). This scale helps in understanding the physical dimensions of the machine relative to the surrounding area, such as adjacent buildings or infrastructure.

Figure 4.4 Screenshot from the 3D model of Frederick Hurda's first chain coal cutting machine located in Poland, which was used widely in English and German mines in the 19th century.

5. CONLCUSION AND OUTLOOK

This document outlines the visualized inventory of the CoalHeritage platform, designed to assist the identification processes that needed to declare coal sites as heritage area, to enhance the management and to support the just transition of the coal sector in coal dependent regions. It specifically details the visualizations for Work Packages 2 and 3, which include information about the current state in various countries (Germany, Greece, France, Poland, Slovenia) (Figure 5.1), as well as the best practices (Figure 5.2).

Figure 5.1 Screenshot of the CoalHeritage sites using a 3D landscape.

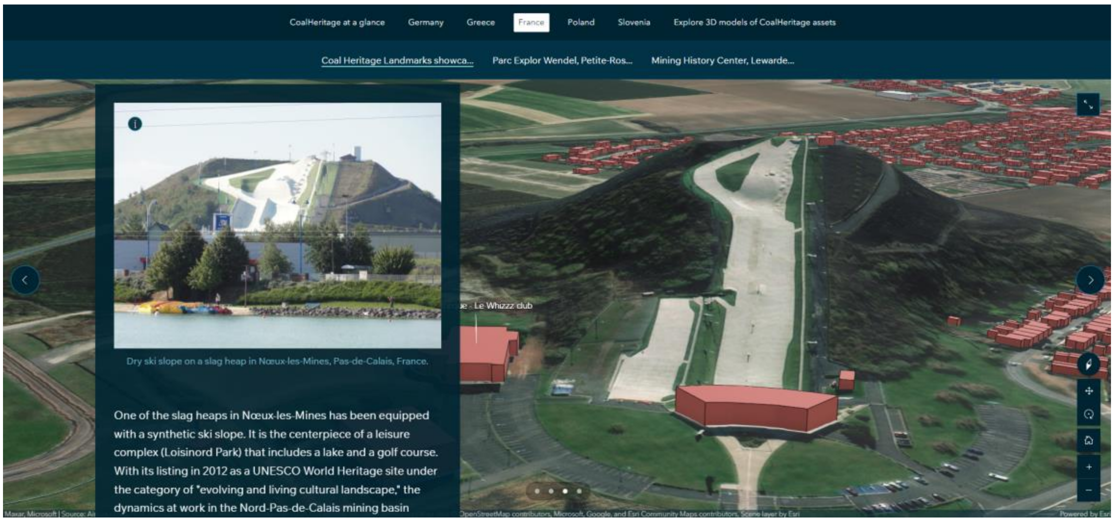


Figure 5.2 Screenshot of a best-practice case in France.

The enhancement of the CoalHeritage database will concentrate on updating and expanding the capabilities of the European Visual Map Journal developed under Deliverable 4.2. This enhancement will involve integrating new datasets, particularly from 3D assets, which will highlight the interactive aspects of the project (Fig. 5.3).

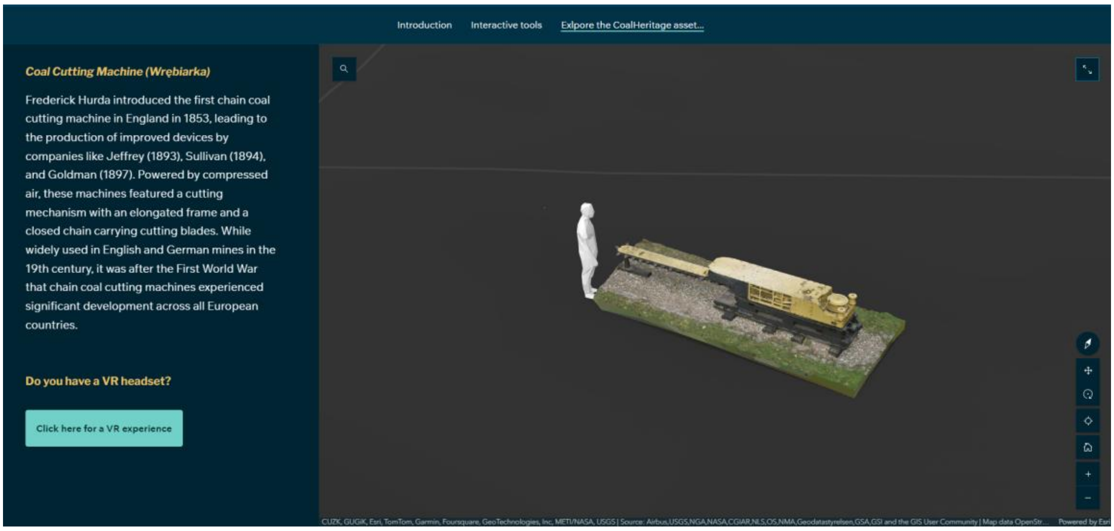


Figure 5.3 Screenshot of a 3D asset within the EVMJ platform.

Additionally, efforts will be made to improve the user experience on the platform. Future work will focus on continuously updating the existing datasets to reflect the latest advancements in WebGIS functionalities. This includes refining the visualization tools to ensure the platform remains a state-of-the-art, the update of existing datasets with additional information, and improving the interactivity through the VR experience. Finally, a User's Guide in the form of a story map will be created to demonstrate the platform's capabilities, ensuring easy navigation for users.

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Appendix CAWI IDI questionnaire & FGI Scenario

Inventory and Management of Mine Resources as Cultural Heritage

Coal Heritage: Conservation and promotion of the Coal Mining Heritage as EU's cultural legac, is an RFCS Accompanying Measure European Project with main goal the development of an interregional network for the protection and promotion of the coal mining heritage in post-mining regions. The project will focus on coal regions that are currently in a transition phase as well as those that have already ceased the exploitation of coal or are near mine closure. The main objectives are: 1) Identification processes needed to declare the coal sites as heritage areas supporting the just transition of the coal sector and regions, 2) Enhanced management in the coal regions in transition supporting the just transition of the coal sector and regions, improving health and safety and minimising the environmental impacts of coal mines in transition, 3) Design and develop a European Visual Map Journal (EVMJ) supporting the just transition of the coal sector and regions and 4) Dissemination and network development supporting the just transition of the coal sector and regions.

CoalHeritage project has received funding from the Research Fund for Coal and Steel (RFCS) under Grant Agreement No.101112138

Privacy Statement
Participation in this survey is voluntary.
If you decide to participate in the survey, you consent to the collection and processing of your personal data.
The data are collected and processed only for research purposes in the context of the implementation of the project CoalHeritage and under the provisions of the General Data Protection Regulation (2016/679/EU).
We use the EUsurvey to conduct the survey. We will not disclose your data to another third party unless disclosure is required by law or is necessary for the fulfillment of the above processing purposes.
The collected data will be kept for a maximum period of 12 months after the closure of the survey unless a longer retention period is required by law or for the establishment, exercise, or defense of legal claims.
As a data subject, you have the right to access, rectification, restriction of processing, erasure, object to processing, portability, as well as withdraw your consent at any time.
Data Controller: Główny Instytut Górnictwa-Państwowy Instytut Badawczy (GIG-PIB), Plac Gwarków 1, 40-166 Katowice, Poland
If you have questions regarding the data processing or the survey details, please contact us by sending an e-mail to gig@gig.eu

I declare that I have read this Privacy Statement, understand the processing of my personal data and I consent to it.

☐ Yes ☐ no

IDI: In-depth Interview Questionnaire

Thank you for participating in this in-depth interview. Its aim is to gain your knowledge and experience related to the inventory and management of mine resources as cultural heritage. Please provide detailed answers that will allow us to better understand this topic.

Introduction to Mine-Related Cultural Heritage

1. What is your view of mine-related cultural heritage? Please answer no longer than 3000 characters.

2. In your experience, are mines in the context of cultural heritage unique in terms of challenges and opportunities? Please answer no longer than 3000 characters.

Inventory of Mine Assets

3. What are your experiences with inventorying mine assets? Please select one of the following options:

☐ No experience in inventorying mine assets
☐Few, indirect experiences in the inventory of mine assets
☐Average experience in inventorying mine assets
☐Long-term and intensive experience in inventorying mine assets.

4. Are there specific elements of the mine assetsat require special attention during the inventory process? Please select one or more of the following categories of mine assets that you consider important for inventorying due to their importance to cultural and historical heritage.

☐Historical mine buildings
☐ Historical mining machines and equipment
☐ Archival documents and mining maps
☐Mining traditions and practices
☐ Mining memorials and monuments
☐Other (please specify).

Inventory methods

5. What inventory methods do you consider the most effective in the case of mine assets? Please select one or more of the following inventory methods that you consider most effective.

☐ Field inventory using modern measurement technologies (e.g. laser scanning, drones).
☐Archival research and analysis of historical documentation
☐ Interactive digital projects and virtual tours of the mine area
☐Application of geospatial technology to manage data regarding mine assets
☐Other (please specify).

6. Are there modern technologies that can be effectively used in the inventory process? Please select one or more of the following modern technologies that you consider effective.

☐ Laser scanning for precise measurement of land topography
☐ Drone technologies to obtain images and data from difficult-to-reach areas
☐Artificial intelligence for automatic processing and analysis of inventory data
☐Virtual reality for creating interactive visualizations of mining areas
☐IT systems for collecting and sharing inventory data
☐Other (please specify).

Mining heritage management

7. What do you consider to be the key challenges in managing mining heritage in your region? Please select one or more of the options below.

☐Threats related to the degradation of historic mine buildings
☐The need for sustainable use of mine assets while minimizing the impact on the environment
☐ Challenges related to preserving mining traditions and culture in the local community
☐ Problems related to financing and support for mining heritage projects
☐Lack of public awareness and education regarding mining heritage
☐The need to revitalize post-mining areas of mines
☐Other (please specify).

8. What are the optimal models for maintaining industrial heritage facilities (state, local government, social, private, Public Private Participation)? Please answer no longer than 3000 characters.

9. Where can/should the funds for maintaining these facilities come from? Please select one or more of the following sources of funds that you consider likely and appropriate to finance the maintenance of industrial heritage sites.

☐Public funds provided by government institutions
☐Grants and subsidies offered by local governments
☐Income generated from the provision of tourism and educational services at heritage sites ☐Private investment and corporate sponsorship
☐ Income from admission tickets and other fees from visitors
☐European funds for industrial heritage projects
☐Other (please specify)

Public participation

10. Do you believe that local communities are actively involved in decision-making processes regarding mining heritage in your region?

☐ Yes, local communities are strongly involved and have a significant influence on decisions.

☐Yes, but their role in decision-making processes is limited
☐I'm not sure
☐ No, local communities are not involved in decision-making processes regarding mining heritage
☐Other (please specify).

11. Do you know whether there are public consultations on the management of mining heritage in your region?

☐Yes, regular public consultations are held
☐Yes, but public consultations are carried out rarely
☐I'm not sure
☐ No, there are no public consultations on mining heritage management
☐ Other (please specify).

12. What are the benefits or challenges of public participation in mining heritage management? Please select one or more of the options below.

☐Increasing the involvement of local communities in preserving mining heritage
☐Developing educational programs and promoting historical awareness among society
☐ Increasing social acceptance for projects related to mining heritage
☐Greater diversity of perspectives and experiences in the mining heritage management process
☐ Potential conflicts between different social groups over different views on mining heritage
☐Limited public understanding of complex mining heritage management issues
☐Other (please specify).

Education and awareness

13. Do you think there are educational programs in your country that may affect mining-related cultural heritage? Please answer no longer than 3000 characters.
14. Can you mention good practices in mining heritage educational programs in your region? Please select one or more of the items below.

☐Inclusion of mining heritage sites in school and university curricula
☐Organization of interactive educational workshops for students
☐ Participation of local communities in educational projects
☐ Creation of interactive websites and educational applications
☐ Cooperation with local cultural institutions and museums as part of educational programs
☐Implementation of internship programs for students in the field of cultural studies and history
☐Other (please specify).

15. What actions do you think can be taken to increase public awareness of mining heritage? Please select one or more of the following actions:

☐Organization of festivals and cultural events related to mining
☐Educational school and university projects on the history of mining
☐Creation of interactive mining exhibitions and museums
☐Educational publications, press articles and information materials on the topic mining heritage
☐ Promotional campaigns in social media
☐Educational workshops and seminars for local communities
☐Other (please specify).

Sustainable development

16. What aspects of development are important in the context of mining heritage? Please select one or more of the options.

☐Development of educational programs and historical awareness in local communities
☐Cultural tourism related to mining heritage
☐ Revitalization of post-mining areas of the mine
☐Creation of jobs related to mining heritage
☐Technological innovations in the field of mining
☐Other (please specify).

17. What examples of successful sustainable development practices in the field of cultural heritage do you consider to be particularly successful? Please select one or more of the following examples.

☐Urban regeneration using cultural heritage
☐ Educational programs and training on the sustainable use of cultural resources
☐ Initiatives to promote cultural tourism with minimal impact on the environment
☐Projects for the adaptation and modernization of historical buildings with respect for cultural heritage
☐Long-term plans for managing cultural heritage, taking into account aspects of sustainable development
☐ Involving local communities in decision-making processes regarding cultural heritage.
☐Other (please specify)

Cooperation and partnership

18. Which institutions or organizations should cooperate in managing mining heritage? Please select one or more of the following.

☐ Government institutions responsible for the protection of cultural heritage
☐Local governments and regional authorities
☐Non-governmental organizations dealing with environmental protection
☐Private enterprises related to mining
☐ Educational institutions, schools and universities
☐Museums and cultural institutions
☐Local communities and social organizations
☐Other (please specify)

19. What are the benefits of cross-sector cooperation in the context of mining heritage? Please select one or more of the following.

☐ Increasing the efficiency of mining heritage management

☐Access to various financial resources and expertise

☐Optimal use of mine assets in a sustainable manner

☐Inclusion of different perspectives and experiences to better identify the needs of local communities

☐Increasing the involvement of local communities in decision-making processes

☐ Enabling a comprehensive approach to mining heritage, combining cultural, social and economic aspects

☐ Other (please specify).

Future perspective

20. What do you see as the main challenges the inventory and management of the mine's resources as cultural heritage?

Demographics

1. Name and surname ……
2. Age …
3. Sex ….
4. Occupation ……
5. Experience: I have experience in the area of...
6. Education: degree, academic/professional degree in field……., specialization…
7. Area of specialization: …………

Thank you for taking the time to share your knowledge and experience in the field of inventorying and managing mine resources as cultural heritage. Your opinion is extremely valuable to further understanding and preserving this important heritage.

FGI Focus Group Scenario

Thank you for participating in this group interview. The aim of our discussion is to obtain knowledge on the participants' perspective and experience related to the inventory and management of mine resources as cultural heritage. Please remember to be open and share your thoughts. All information provided during the interview will be treated as confidential.

Introduction to the topic: Coal Heritage project information

1. What does the mining heritage mean to you?
2. What challenges do you perceive as crucial for managing mining heritage in your region?
3. In your opinion, are local communities actively involved in decision-making processes regarding mine-related heritage? (or should it be). Can you list a good practice in this scope?
4. What kind of actions do you think can be taken to increase public awareness of the mining heritage?
5. In your opinion, are there any guidelines or strategic plans that take into account the simultaneous pursuit of preserving the heritage associated with the mines and stimulating the sustainable development of local communities?
6. What inventory methods do you consider effective for mining resources, given their importance for cultural and historical heritage?
7. What elements (assets) related to mines do you consider important to inventory, given their importance for cultural and historical heritage?
8. Do you have any additional comments or suggestions regarding the inventory and management of mine resources as cultural heritage?
9. What descriptive attributes (fields) could be included in the Coal Heritage geospatial database? For example e.g. Location and Coordinates, Operational History?

Thank you for your participation in this survey. Your opinions are extremely important to understanding and preserving the mining heritage.

i. Experts views of geodatabase for coal heritage sites

“The cultural heritage associated with mines is an extremely important element of the history and identity of many communities around the world. First of all, mines play a key role in the economic development of many regions . (…) Mines are also a place where unique traditions and customs were formed. Miners formed their own communities with unique rituals, festivals, and folklore. Traditions such as St. Barbara's Day, the miners' holiday celebrated on December 4 in Poland are living proof of the durability of the mining cultural heritage. The mines are also of educational and tourist importance.”

“Many historic mines are now archaeological sites that offer insights into past techniques and ways of life. These sites are often important sources for research into the industrial development and social organization of past civilizations. The social structure and communities around mines have often been strongly influenced by mining. This includes both positive aspects, such as community building and economic advancement opportunities, and negative impacts, such as social inequalities and health risks for workers. “

“The physical remnants of mining, such as machinery, buildings, and tools, are valuable artifacts as part of the industrial heritage. These sites can serve as open-air museums and educational resources, and can offer a large variety of educational activities. For educational purposes, field trips for students of all levels as well as for the broad public and professionals can take place. In addition, old mining areas can attract a large number of researchers working on geology, metallogeny, and mineralogy but also on mining, ore beneficiation, archaeology and archaeometallurgy, as well as economic, political, and social sciences.”

“One of the main challenges of mining heritage is environmental degradation. Mines, especially those that are out of service, can pose a threat to safety. Old shafts, tunnels and structures can collapse, requiring careful containment and monitoring. Maintenance and protection of mining monuments is a complicated and expensive undertaking. It requires expertise, materials and technology to maintain the authenticity and integrity of these objects. Mining heritage often includes unique skills and knowledge that can be difficult to pass on to new generations. This is particularly important in the context of rapidly changing technologies and societal changes.”

“Mining has the most rich potential among the various sectors of the specific industry. After the end of operation, however, the typical resources in the form of building infrastructure, land development, but also the mine pit are interesting for the future in terms of development.”

“On the plus side, I think that industrial heritage is more popular than more traditional heritage, particularly in highly industrial regions. People are proud of this heritage and they know the importance of the mine in shaping the landscape and the mentality of the area. So it's also an emotional heritage that's not always easy to grasp, because reactions of visitors or donors can sometimes be a little irrational, because there can be so much emotion involved in this relationship with the past. In Northern France, the mines closed at the beginning of the 1990s, leaving us with only a handful of former miners to provide direct testimonies, so we are working on digital devices to continue to have a dialogue in the future between these testimonies and our visitors, whose generational link with the mine is weakening as time goes by. So we're going to have to reinvent ourselves in the coming years to continue to be relevant to visitors whose link with the mine will inevitably be very different.”

“Coal mines are a great challenge as wide objects of coal exploration, both on the surface and underground. Mostly these were wide areas with many industrial objects. Also towns of coal-mining areas hold specific features. Many coal districts in Europe cultivated their land after closure or are in the process doing that. To my opinion also in the frame of cultural heritage these lands must be kept in good condition, as highly as possibly to be used as environments for different public and also modern “low-carbon” industrial activities. Many coal areas will still remain "energy locations" (e.g. installing and producing solar and/or wind electricity,

and/or geothermal energy). There are already many cases as good practices in Europe with co-existing multi-activities including a care for industrial/cultural heritage."

"Maintaining industrial heritage facilities requires a thoughtful approach, with various models available depending on the circumstances. State ownership and management, for instance, involve national agencies or governments overseeing these sites, ensuring proper funding and professional care, especially for significant national assets. Meanwhile, local government ownership allows for tailored preservation efforts, tapping into local knowledge and funding sources, and fostering community pride and involvement."

ii. Experts view regarding the inventory of Mine Assets

"In North Rhine-Westphalia in particular, a wide range of training structures have now developed in the field of post-mining and industrial heritage. One example is the post-mining research centre at the Georg Agricola University of Applied Sciences in Bochum. The German Mining Museum Bochum, Leibniz Research Museum for Georesources, also regularly offers programmes and exhibitions for a wide audience. Within the German Mining Museum Bochum, there is the Mining History Document Centre (montan.dok), which not only collects and documents the material heritage of mining, but also researches the industrial heritage of the mining industry in university contexts and represents it in teaching."

"Greece has a rich history of mining, dating back thousands of years, with significant archaeological sites and historical records documenting mining activities. Archaeological studies in Greece may focus on excavations and research related to ancient mining sites, such as the silver mines of Lavrion or the gold mines of Thrace. These studies contribute to our understanding of ancient mining practices and their cultural significance. Geology and mining engineering programs at Greek universities may include courses on the history and technology of mining in Greece. Students may learn about ancient mining techniques as well as modern mining practices and their impact on the environment and society."

"We started with this small inventory, and after collecting all archival inventories regarding slag heaps, residential buildings housing urban buildings, etc. , we have also created our inventory of world cultural heritage. In fact, two approaches define the universal and unique value of these cultural heritage sites and we make a selection. Therefore, it urged our French state and French experts to select a list of these elements. That's why we only have 20% of the world heritage inside my region. That's why it was a selection. That's why I said that any legacy is, among other things, a construction, but it is one thing, it is a choice. So for six years we were involved in major inventories of natural sites or buildings, etc., to learn about the history, to see the archives, which was a really serious task. But I would say that if you come up with, if you create an inventory, you need to determine who will manage it. Because it's something alive. It's a living thing. This is not a static photo of what you have. Things are sticking. Some things need to be demolished. The situation needs to change to welcome new users, such as economic or housing projects. So you need to connect at the same time. If you don't do this, people usually accuse you of freezing the territory and blaming it on the legacy. We are becoming expensive. It becomes black, gray and modern. Modern architecture is beautiful and inexpensive to replace its heritage. So heritage is obviously a living thing. This needs to be adjusted, but if you want to give a weapon to a legacy opponent, you can very easily give them

something to erase or leave it at that. So this is something that needs to be put into, I mean from the beginning of the project, very much involvement from the very beginning in making choices. It's true that sometimes you have to make choices, but don't bow down to going against things because the legacy will be lost."

"A lot depends on defining the purpose of the spatial database, because it must be so. We have to be very careful about what happens with this, and for me it has to be as simple as possible, and the more you add to it, we will have to take into account management issues, because one of the things that is really happening is important consistency of terms used, thesaurus, and so on. So that you can find yourself. Search and find information reliably, and you have to work hard to determine exactly what date should be included in the database and what it should be used for, otherwise a monster will be created that will be useful." An expert from Great Britain agreed with the above statement, adding that: " I really agree with the above assessment, it has to be something simple and understandable to people, while he wants something very, very technical. I don't know, I won't make any further statements, I will just make the conclusive statement that once again Britain is connected to the continent in terms of history, in terms of, as you know, so maybe there was no Brexit, but it is connected to the continent. So that's the lesson."

In the topic of the Coal Heritage geospatial database, FGI experts noticed that mining heritage, especially coal mining, plays a key role in the history of many regions around the world. A geospatial database like Coal Heritage can be an essential and unique tool for managing and protecting these resources. Experts concluded that to be effective, it must include a wide range of descriptive attributes that enable a comprehensive understanding and management of mining heritage. Location and geographical coordinates, operational history, mining types and structures, mining technology, geological data, environmental impact, sociocultural aspects, documentation and archives, state of preservation and accessibility and tourism are the key categories of attributes that should be considered as priorities in the database. Therefore, the database will not only be a management tool, but also an educational and promotional platform supporting the protection and popularization of mining heritage."