

GEO-COAT

GEO-COAT KBE TOOL MANUAL

1. Introduction

This document describes how to use the Geo-Coat KBE tool. Geo-Coat KBE tool consist of following DSS modules:

- Cost of Energy Estimator
- Environmental Impact Estimator
- Knowledge-Based System (KBS) and database

Cost of Energy Estimator:

This module uses Levelised Cost of Energy (LCOE) methodology to estimate how the adoption of an innovative coating technology can affect the cost of energy throughout the lifecycle of the plant.

Environmental Impact Estimator:

Environmental Impact Estimator uses a Life-Cycle Assessment (LCA) methodology using SimaPro to estimate the environmental impacts.

Knowledge-Based System (KBS) and database:

This module can be used for representing, storing and managing data and experimental results about different types of entities including substrates, coating processes, materials, design-of-experiment (DoE) metamodels, and parameterised cost, life cycle assessment and heat-affected zone models. This module is only available for consortium members.

2. Home Page

- This page has a table for the application area. There are six different application areas.

Application Area ID	Application Areas	Coating Selected By The Project	Coating Composition (Mol. Ratio)	Coating Composition (wt.%)	Deposition/Consolidation Process
S1	Pipes & Casings	LC_HEA2	CoCrFeNiMo 0.85 (HEA2)	Co19.19 Cr19.19 Fe19.19 Ni19.19 Mo26.56	Laser Cladding (LC)
S2	Valve stem/turbine (blades)	LC_HEA2	CoCrFeNiMo 0.85 (HEA2)	Co19.19 Cr19.19 Fe19.19 Ni19.19 Mo26.56	Laser Cladding (LC)
S3	Turbine rotors (+diaphragms)	LC_HEA2	CoCrFeNiMo 0.85 (HEA2)	Co19.19 Cr19.19 Fe19.19 Ni19.19 Mo26.56	Laser Cladding (LC)
S4	Turbine blades	LC_HEA2	CoCrFeNiMo 0.85 (HEA2)	Co19.19 Cr19.19 Fe19.19 Ni19.19 Mo26.56	Laser Cladding (LC)
S5	Pump impellers	HIP_Ti64+10%TiB ₂	-	Ti6Al4V 90 TiB ₂ 10	Hot Isostatic Pressing (HIP)
S6	Heat exchanger tubes	ENP_LP (Low Phosphorus)	Ni-P/Ni-P-PTFE	-	Electroless Nickel Plating (ENP)

- If we click on a particular application area then we get another table for illustrate the coating system ranking for this application area.

This table illustrates the coating system ranking for Pipes & Casings

Search:

Application area	SOA/Coating types	Corrosion and erosion						
		Erosion-corrosion (mm/y)	Corrosion penetration (max.µm)		Stress corrosion cracking (SCC)	Permeability	Pitting	Cracks
			Flow through corrosion (7 days)	Static corrosion (60 days)				
S1	P265GH	15.8	200	20	N/A	+	-	-
S1	LC_HEA2	N/A	N/A	0.1	-	-	-	-
S1	HVOF_CA2	N/A	50	150	+	-	+	+

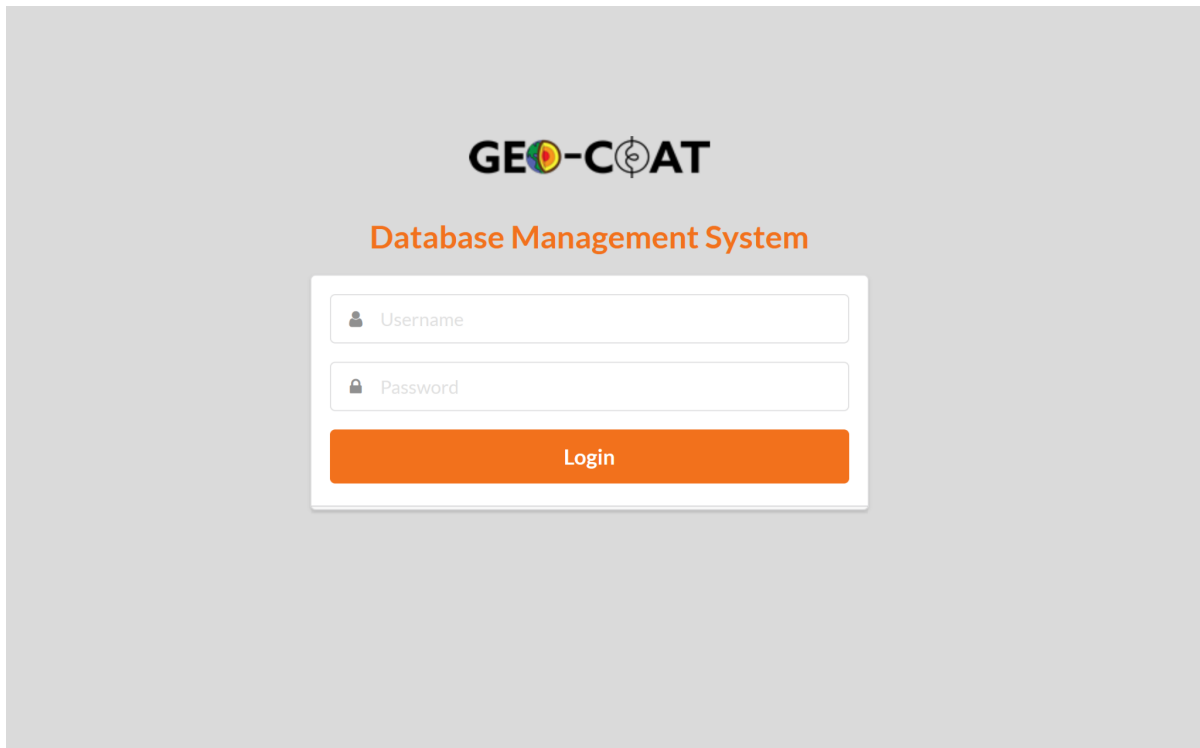
+ : corrosion damage is present
 - : corrosion damage is NOT present
 N/A : not relevant or test not performed.
 * : max. depth of crack.
 ** : through the thickness of the coating
 HVOF : High Velocity Oxygen Flow
 CA2 : C_{9.5}Cr_{10.9}Ni₂₀ Cermet

- There is another section on this page for updating the Geo-Coat database.

Update the Geo-Coat database (for consortium members only)

[Go to Geo-Coat Database](#)

- We can go to the Geo-Coat database management system by clicking on the “Go to Geo-Coat Database” button. It will open another new tab for the Geo-Coat database management system. This module is only for the consortium members only.



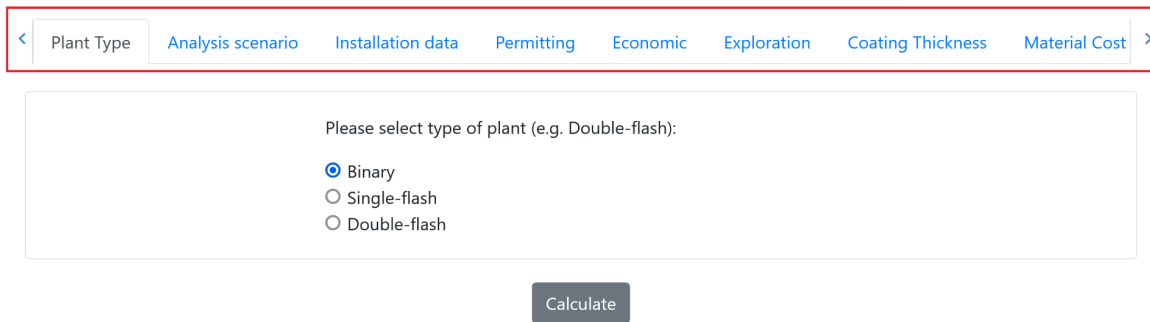
The screenshot shows the login interface for the GEO-COAT Database Management System. At the top center is the logo "GEO-COAT", where the "O" is a globe icon and the "C" is a dollar sign icon. Below the logo is the title "Database Management System" in orange text. The login form consists of two input fields: "Username" with a person icon and "Password" with a lock icon. Below these fields is an orange "Login" button.

3. Cost of Energy Estimator

This module estimates the cost of energy by using the Levelised Cost of Energy (LCOE) metric. Please follow the steps below to calculate Levelised Cost of Energy (LCOE):

- There are a total 13 tabs for different inputs marked with a red rectangle.

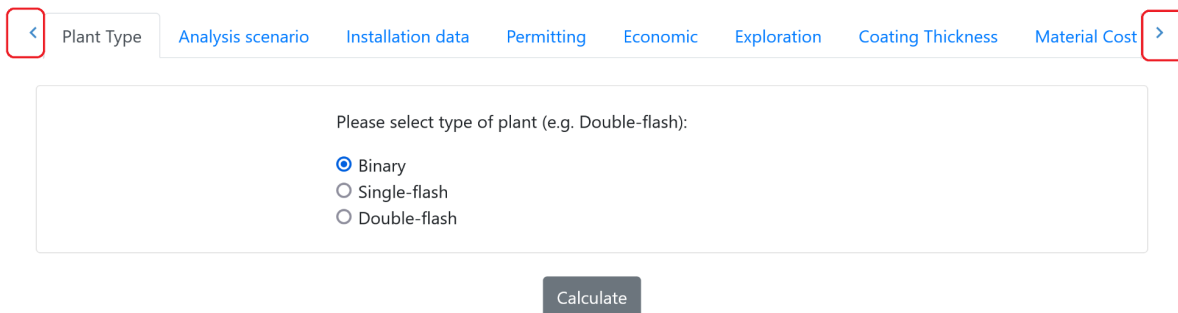
This tool helps to estimate the impact of new coating technology developed in the project/ It estimates the cost of energy by using the Levelised Cost of Energy (LCOE) metric.



The screenshot shows a horizontal tab bar with eight tabs: "Plant Type", "Analysis scenario", "Installation data", "Permitting", "Economic", "Exploration", "Coating Thickness", and "Material Cost". The "Plant Type" tab is selected and highlighted with a red rounded rectangle. Below the tab bar is a form with the text "Please select type of plant (e.g. Double-flash):" and three radio button options: "Binary" (selected), "Single-flash", and "Double-flash". A "Calculate" button is located below the form.

- This tab bar has a left and right button for scrolling the tabs. These buttons are marked with two red rounded rectangles.

This tool helps to estimate the impact of new coating technology developed in the project/ It estimates the cost of energy by using the Levelised Cost of Energy (LCOE) metric.



This screenshot is identical to the one above, but with red rounded rectangles highlighting the left and right navigation arrows on the tab bar.

- Click on the “Calculate” button for getting the Levelised Cost of Energy (LCOE). Then the result section will appear. It also takes some time to calculate.

LCOE Summary

Scenario	SOA LCOE (€/MWh)	Geo-Coat LCOE (€/MWh)	Improvement
All Components	1860.619	77.455	95.84% decrease

- If we want to view the all component summary just click on the “All Components” marked with a red rectangle. Then another tab will appear under this table.

4. Environmental Impact Estimator

This module helps to estimate the environmental impacts of Geo-Coat technologies developed in the project for geothermal components protecting corrosion, erosion and scaling damages occurred using a Life Cycle Assessment (LCA) tool SimaPro 9.0.0.49, considering the life cycle impact assessment (LCIA) methodology IMPACT 2002+ version 2.14.

ISO14040 and ISO14044 standards LCA methodology used.

Data inventories of the physical sizes of the components for pipes, well casings, turbine components (geothermal components) have been carried out for an Icelandic perspective power plant where Geo-Coat technologies will be adopted instead of recommended state of art (SOA) materials. The materials used in that plant have not been considered.

For comparative LCIA studies with adoption of the best candidate Geo-Coat technology and recommended state of art (SOA) materials employed for geothermal components in a geothermal power plant, the LCIA impact results have been evaluated and analysed for 1 MW installed capacity of the plant.

Please follow the steps below to evaluate the LCIA results:

- There are several LCIA methods provided by the SimaPro LCA tool. See the red marked rectangle which is a dropdown list. All methods have been attached here.

To analyze the Life Cycle Assessment click on the Analyze button

Environmental Impact Methodology:

- Click on the Analyze button to get LCIA results. It may take some time to complete the evaluation.
- Finally, the result section will appear under this section and show the comparative LCIA results such as characterisation, endpoint damage and single score categories with adoption of the best candidate Geo-Coat technology and recommended state of art (SOA) materials in terms of 1 MW capacity of the plant.

Analyzed result:

Environmental Impact Methodology: IMPACT 2002+

[Characterisation](#) [Damage Assessment](#) [Single Score](#)

Characterisation

Search:

Indicator Name	Unit Name	Best GeoCoat Technology	Recommended SOA materials
Aquatic acidification	kg SO2 eq	1.36760e+3	4.04489e+3
Aquatic ecotoxicity	kg TEG water	43.2342e+6	57.6797e+6
Aquatic eutrophication	kg PO4 P-lim	456.370e+0	171.394e+0
Carcinogens	kg C2H3Cl eq	1.40212e+3	5.89605e+3
Global warming	kg CO2 eq	100.272e+3	426.345e+3
Ionizing radiation	Bq C-14 eq	1.31067e+6	6.41994e+6
Land occupation	m2org.arable	3.42288e+3	6.69033e+3
Mineral extraction	MJ surplus	156.317e+3	73.7537e+3
Non-carcinogens	kg C2H3Cl eq	2.45098e+3	8.93793e+3
Non-renewable energy	MJ primary	1.38356e+6	6.14762e+6

Indicator Name **Unit Name** **Best GeoCoat Technology** **Recommended SOA materials**

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