Digital Solutions for a Bio-Based Future: Empowering Industry and Consumers

WEBINAR

8th April 2025

BIORADAR DIGITAL PLATFORM TOOLS

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AI/Digital Twin/DSS lead at IRIS Technology Solutions

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Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CBE JU. Neither the European Union nor the CBE JU can be held responsible for them.

Who we are

IRIS Technology Solutions S.L. is a Catalan SME with a global ambition

- Funded 2007
- 69 Employees
- 4.9M€ Turnover (2023)
- Deep Tech company specialized in Real-Time Process Monitoring and Industry Digitization
- Team of multidisciplinary and experienced photonics, software, telecommunications and data analytics experts

SMAC

Tailor-made SMAC (Social, Mobile, Analytics and Cloud) solutions for Industry.

- Adapt business to stay competitive and relevant in Industry 4.0.
- Turnkey digital solutions tailored to your needs.
- **Digital tools:** AI, Decision Support Systems, Digital Twins (in-silico process simulations).
- **Smart sensors:** Transform your process monitoring data into valuable insights.
- Recent circular economy EU projects: BIORADAR, PRESERVE, CIRCULAR FOODPACK, MERLIN.

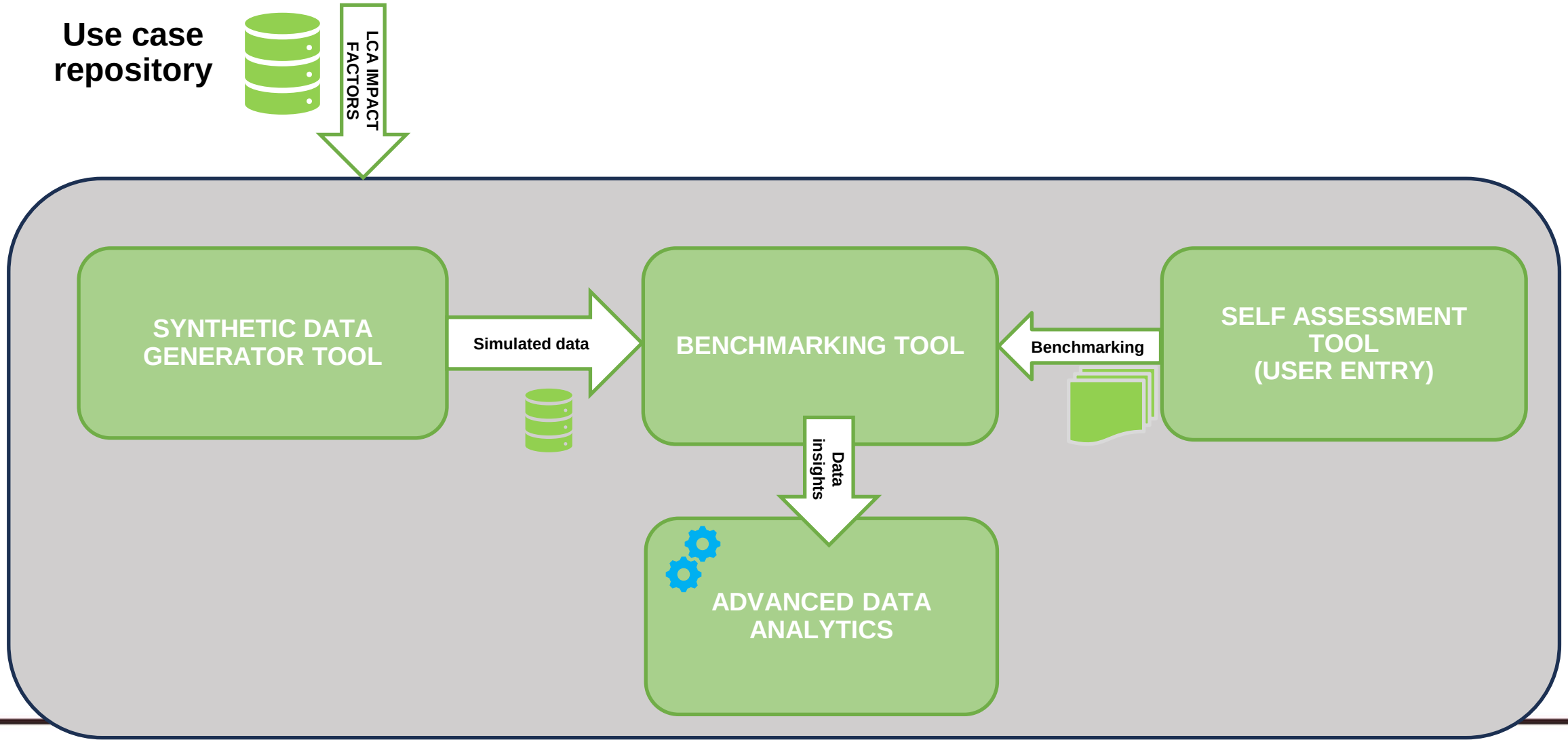
BIORADAR DIGITAL PLATFORM

- **Circular Economy, Bio-based systems, process and supply chains**
- **Industrial environmental impact assessment and reduction**
- **Leverage LCA (Life Cycle Assessment) data**

Empowering industry and stakeholders so they can **evaluate and compare their own environmental impact (Self Assessment Tool)**, providing information of **where to focus to optimize**

- **Data availability**
  - Real use case data from **Fertilizer**, **Textile** and **Packaging** sectors
  - **Realistic synthetic data** generated from real data using advanced statistics
- **Benchmarking:** energy use, water consumption, carbon emission, land use, …
- **Advanced data analytics** with AI and machine learning

Intereaction between different modules



DATA REPOSITORY AND SYNTHETIC DATA GENERATOR

Combines real data results from Bioradar project sectors (Fertilizer, Textile and Packaging) with synthetic datasets to train the AI-driven benchmarking and analytics platform

- The data repository has been consolidated with a complete set of datasets for the fertilizer, textile and packaging sectors (LCA analysis)

- The synthetic data generator performs an automatic statistical analysis of the real data (seed cases, e.g. all fertilizer, fertilizer feather meal, ..) and then generates the synthetic data from it.

This approach uses top-notch statistical/mathematical techniques to generate realistic synthetic data

Advanced statistics – uses seed data cross-correlations, means and standard deviations as input to a Monte Carlo simulation using Eigenvectors and matrix transformations to produce the simulated data.

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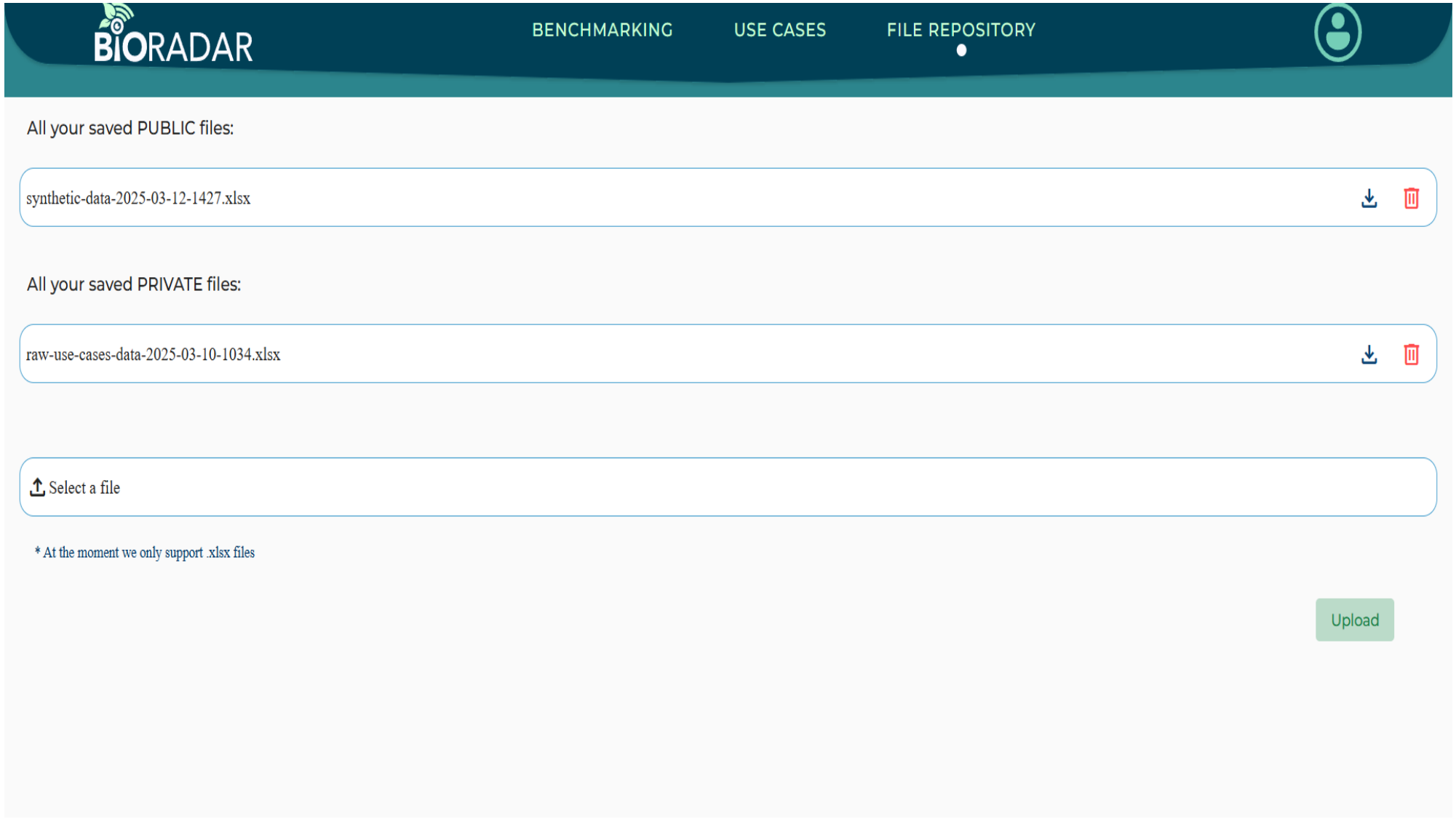
DATA REPOSITORY



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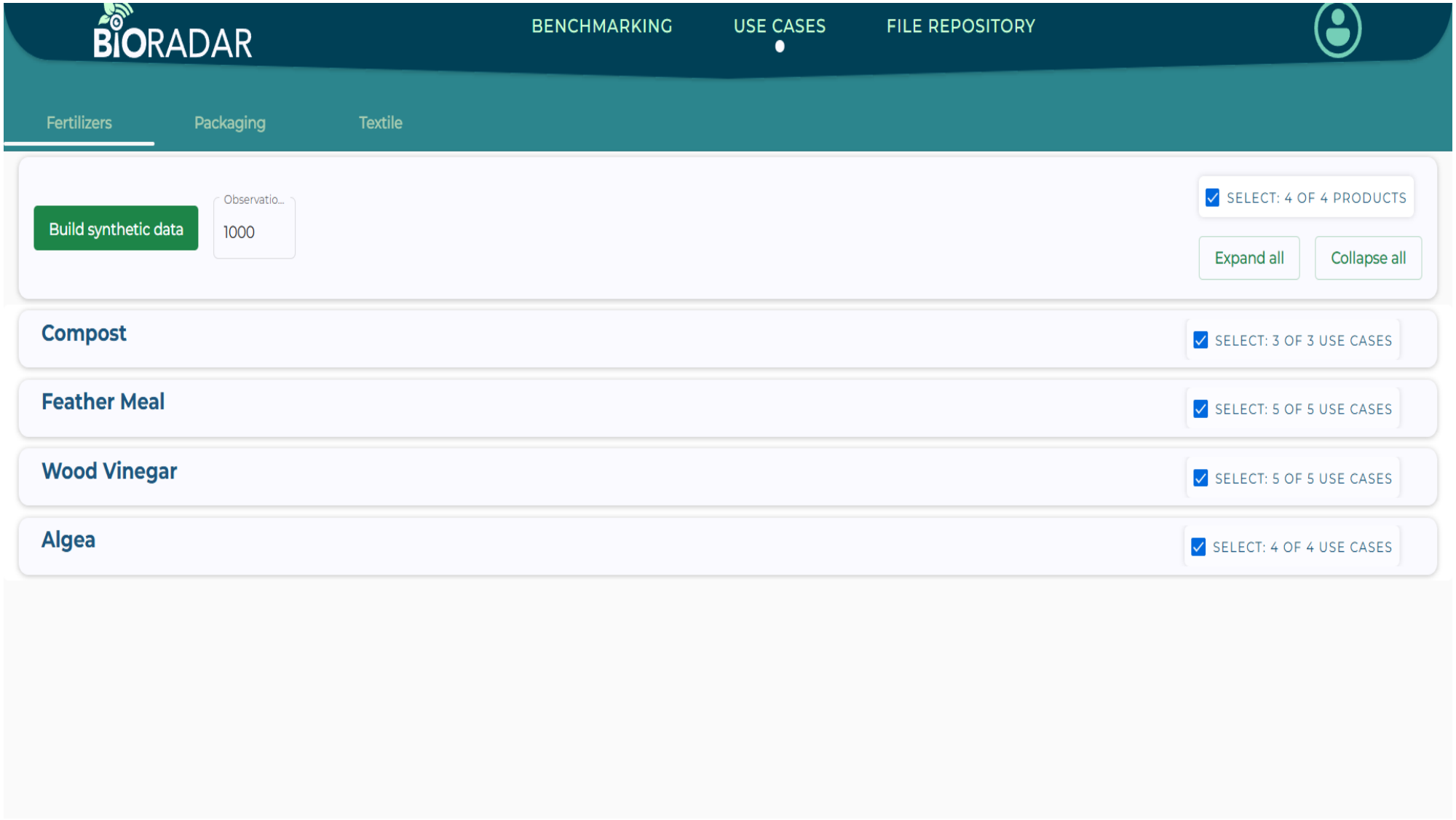

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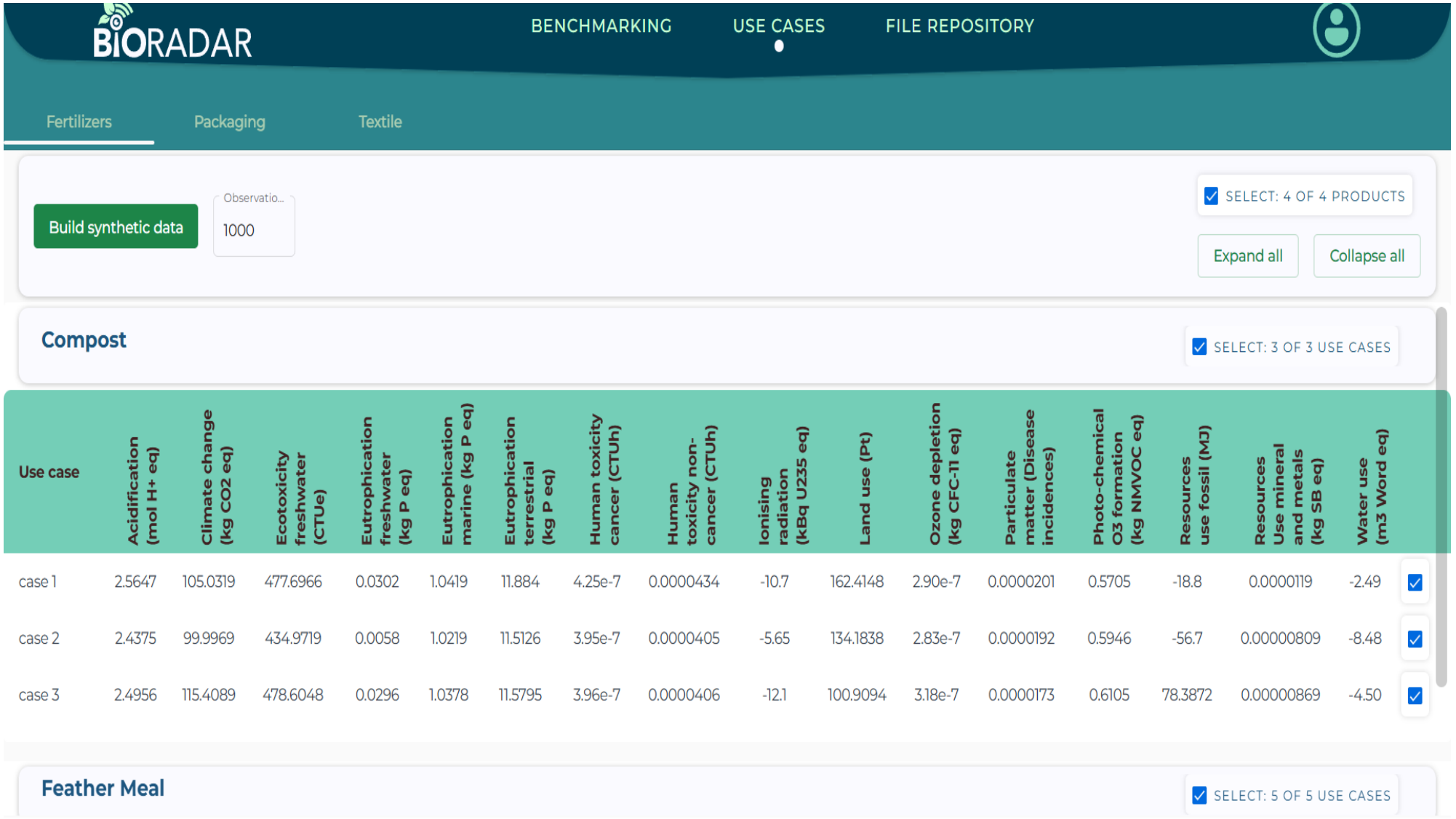
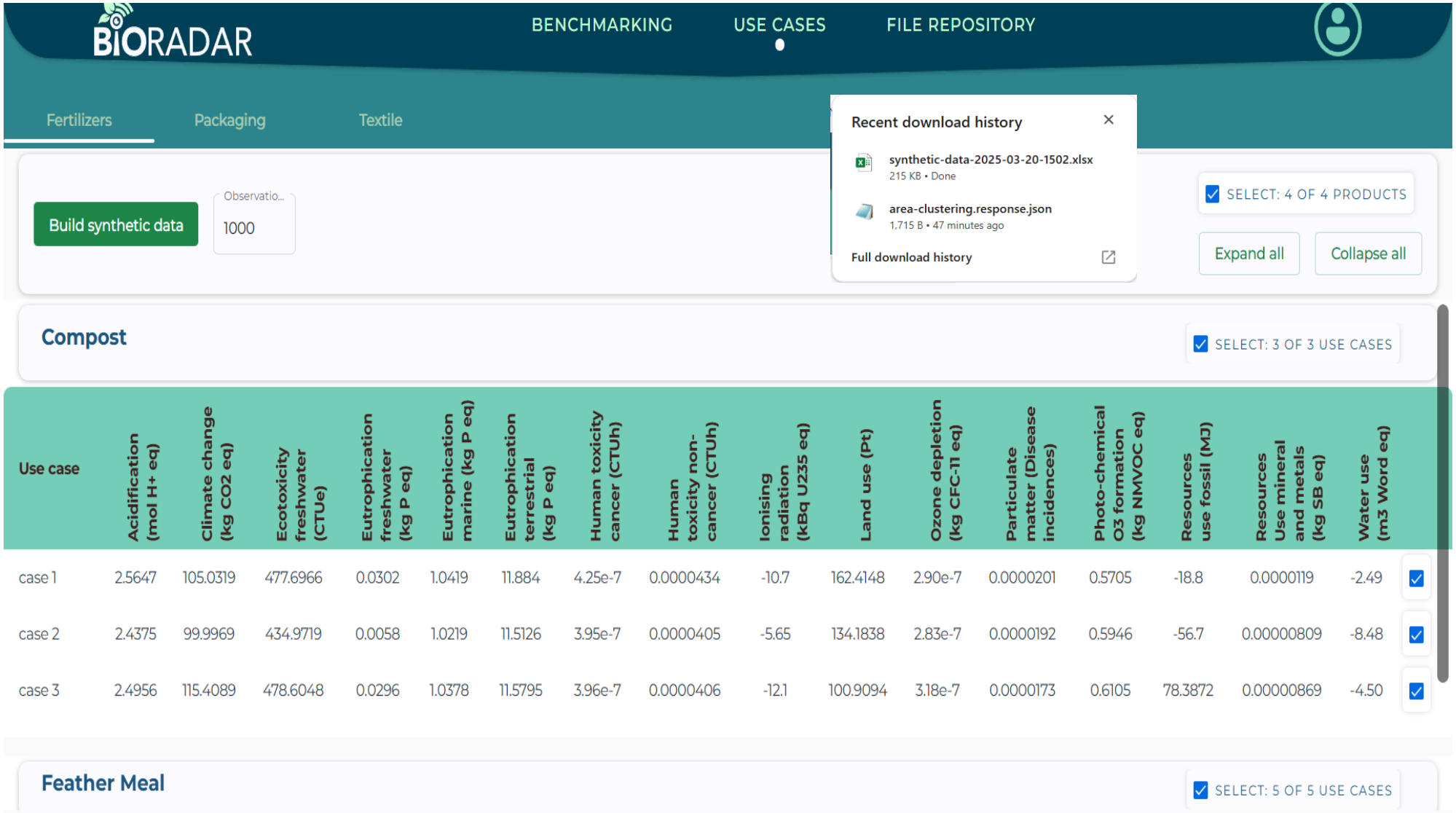
DATA REPOSITORY



Use case	Acidification (mol H+ eq)	Climate change (kg CO2 eq)	Ecotoxicity freshwater (CTUe)	Eutrophication freshwater (kg P eq)	Eutrophication marine (kg P eq)	Eutrophication terrestrial (kg P eq)	Human toxicity cancer (CTUh)	Human toxicity non-cancer (CTUh)	Ionising radiation (kBq U235 eq)	Land use (Pt)	Ozone depletion (kg CFC-11 eq)	Particulate matter (Disease incidences)	Photo-chemical O3 formation (kg NMVOC eq)	Resources use fossil (MJ)	Resources Use mineral and metals (kg SB eq)	Water use (m3 Word eq)
case 1	2.5647	105.0319	477.6966	0.0302	1.0419	11.884	4.25e-7	0.0000434	-10.7	162.4148	2.90e-7	0.0000201	0.5705	-18.8	0.0000119	-2.49
case 2	2.4375	99.9969	434.9719	0.0058	1.0219	11.5126	3.95e-7	0.0000405	-5.65	134.1838	2.83e-7	0.0000192	0.5946	-56.7	0.00000809	-8.48
case 3	2.4956	115.4089	478.6048	0.0296	1.0378	11.5795	3.96e-7	0.0000406	-12.1	100.9094	3.18e-7	0.0000173	0.6105	78.3872	0.00000869	-4.50

SYNTHETIC DATA GENERATOR



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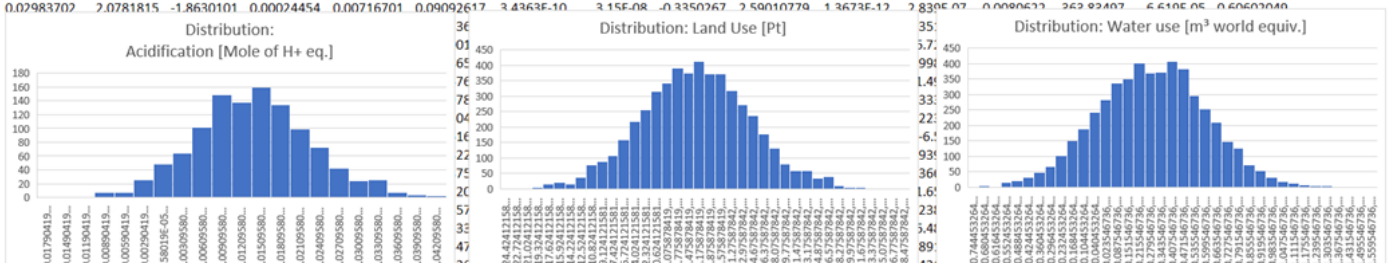
SYNTHETIC DATA GENERATOR

RESULT OF SIMULATION (5000 rows)

Acidification [Mole of H+ eq.]	Climate Change - total [kg CO2 eq.]	Ecotoxicity, freshwater - total [CTUe]	Eutrophication, freshwater [kg P eq.]	Eutrophication, marine [kg N eq.]	Eutrophication, terrestrial [Mole of N eq.]	Human toxicity, cancer - total [CTUh]	Human toxicity, non-cancer - total [CTUh]	Ionising radiation, human health [kBq U235 eq.]	Land Use [Pt]	Ozone depletion [kg CFC-11 eq.]	Particulate matter [Disease incidences]	Photochemical ozone formation, human health [kg NMVOC eq.]	Resource use, fossils [MJ]	Resource use, mineral and metals [kg Sb eq.]	Water use [m³ world equiv.]
0.00832197	0.16469245	50.708814	0.00068082	0.00390458	0.14741869	1.5169E-09	4.1589E-08	0.6599198	9.06939301	7.4643E-13	2.028E-07	-0.003936	220.72175	7.657E-05	-0.3851076
0.02951657	6.68647289	-2.6217832	0.00090853	0.01260746	0.05732146	1.2219E-09	5.658E-08	0.8597921	10.7823551	3.9151E-13	9.264E-08	0.013022	45.172396	9.5818E-05	0.38448701
0.01956615	8.47964299	8.7274646	-0.0001501	0.00452926	0.17761238	9.5106E-10	6.4804E-08	0.2946364	-2.9713457	7.1352E-13	6.326E-09	0.059024	551.48626	3.0057E-05	0.35037227
0.0125762	4.34620493	36.035397	-0.0001455	0.00648805	0.06820446	-3.623E-10	7.4925E-08	0.1081862	7.39041353	1.52E-12	1.602E-07	0.0179457	64.476203	5.4319E-05	0.44657734
0.01455757	7.52125698	9.7905296	-0.0002453	0.00147862	0.02802446	8.0126E-10	-1.005E-08	0.5644961	13.6268761	5.4382E-13	2.069E-07	-0.019535	-98.806881	9.9768E-05	0.63337281
0.02430375	2.66548749	13.249846	0.00053749	-0.0106632	0.21557384	7.5026E-10	1.0474E-07	-0.544884	11.8808361	1.2066E-12	4.841E-08	0.0125026	91.667141	7.7358E-05	0.14409681
0.02084043	-0.0982526	33.845962	0.00115676	0.01028764	0.13210415	8.1599E-10	1.0625E-07	1.1870965	5.40730621	7.1765E-13	6.686E-08	0.0139235	91.024104	-7.598E-06	0.2327861
0.01851008	17.7685685	35.795323	0.00021787	0.0088481	0.04040118	9.0776E-10	-2.522E-08	0.0820562	-5.4836878	1.4234E-12	5.762E-08	-0.0127255	57.540478	-1.97E-05	0.5642819
0.02463987	-0.3778303	16.322503	7.9835E-05	-0.0132056	-0.0488489	1.7636E-09	1.1358E-07	0.3824322	13.3342339	-9.046E-15	-9.91E-09	0.0245175	85.032391	1.6581E-05	1.01776118
0.02983702	2.0781815	-1.8630101	0.00024454	0.00716701	0.09092617	3.4363E-10	3.15E-08	-0.3350267	2.59010779	1.3673E-12	2.839E-07	0.0080622	363.83497	6.619E-05	0.60602049



GENERATED DATA

Acidification [Mole of H+ eq.]	Climate Change - total [kg CO2 eq.]	Ecotoxicity, freshwater - total [CTUe]	Eutrophication, freshwater [kg P eq.]	Eutrophication, marine [kg N eq.]	Eutrophication, terrestrial [Mole of N eq.]	Human toxicity, cancer - total [CTUh]	Human toxicity, non-cancer - total [CTUh]	Ionising radiation, human health [kBq U235 eq.]	Land Use [Pt]	Ozone depletion [kg CFC-11 eq.]	Particulate matter [Disease incidences]	Photochemical ozone formation, human health [kg NMVOC eq.]	Resource use, fossils [MJ]	Resource use, mineral and metals [kg Sb eq.]	Water use [m³ world equiv.]
0.01537	8.1555	13.155	0.00035003	0.0048705	0.0531	6.068E-10	5.199E-08	0.39755	6.583	7.0715E-13	1.147E-07	0.0138225	131.765	3.0015E-05	0.3225
0.00923481	11.2352196	17.175624	0.00048363	0.00673095	0.07339768	7.8234E-10	6.7472E-08	0.4998538	8.36790165	9.2327E-13	8.245E-08	0.018353	182.76589	4.0567E-05	0.31183409

	Acidification (terrmate	Chan	xicity (Freshw	oxicity (Ma	icity (Terre	cation (Fres	hication (Mar	n Toxicity (Car	oxicity (nonr	nising Radiatio	Land Use	zone depletio	riculate mat	O3 formation	3 formation	rces Use (Frc	es Use (N	Water Use
Acidificatic	1																	
Climate Ch	0.743684	1																
Ecotoxicity	-0.62274	-0.35735	1															
Ecotoxicity	-0.6362	-0.35805	0.9996326	1														
Ecotoxicity	-0.16366	-0.25066	0.8123401	0.797636	1													
Eutrophica	0.527825	-0.15579	-0.3189129	-0.33849	0.243929	1												
Eutrophica	0.48093	-0.16967	-0.1471444	-0.16822	0.419159	0.982285	1											
Human To	-0.64984	-0.19189	0.94657214	0.95154	0.621719	-0.59837	-0.44344	1										
Human To	-0.64065	-0.37187	0.99969803	0.999858	0.801257	-0.32853	-0.15859	0.947753282	1									
Ionising Ra	0.498402	-0.15008	-0.1550384	-0.17639	0.416598	0.982187	0.999718	-0.448303887	-0.16694	1								
Land Use	0.573945	-0.07929	-0.2611473	-0.28178	0.320436	0.991916	0.991954	-0.539981405	-0.27308	0.993352096	1							
Ozone dep	-0.35471	-0.42785	-0.1894626	-0.19066	-0.33911	-0.16902	-0.24769	-0.112910062	-0.18186	-0.24764474	-0.25644	1						
Particulate	0.999677	0.741226	-0.6283355	-0.64204	-0.16884	0.526103	0.477867	-0.653316337	-0.64633	0.495592563	0.571083	-0.33199932	1					
Photocher	-0.64137	-0.22756	0.71984511	0.721608	0.381337	-0.6543	-0.55165	0.837588256	0.720944	-0.55128354	-0.6317	0.409631234	-0.63076	1				
Photocher	-0.95452	-0.76496	0.65978069	0.666682	0.279602	-0.45093	-0.39057	0.669600633	0.673327	-0.4045077	-0.49246	0.512820915	-0.94816	0.77082044	1			
Resources	-0.47076	0.018679	0.88624984	0.888395	0.615204	-0.60509	-0.4473	0.969922585	0.88246	-0.44638911	-0.52792	-0.13942364	-0.47223	0.845962217	0.523846	1		
Resources	0.572657	-0.02244	-0.1013702	-0.12517	0.491614	0.938106	0.974873	-0.373334902	-0.1173	0.979144596	0.969254	-0.26688647	0.571462	-0.45636458	-0.44299	-0.32813	1	
Water Use	0.570202	-0.11929	-0.4932855	-0.51062	0.047508	0.980113	0.925685	-0.742341317	-0.50088	0.92610909	0.954968	-0.08726119	0.569915	-0.74188961	-0.51042	-0.74834	0.865585	1

VALIDATION: compare averages, standard deviations and cross correlations with target statistics

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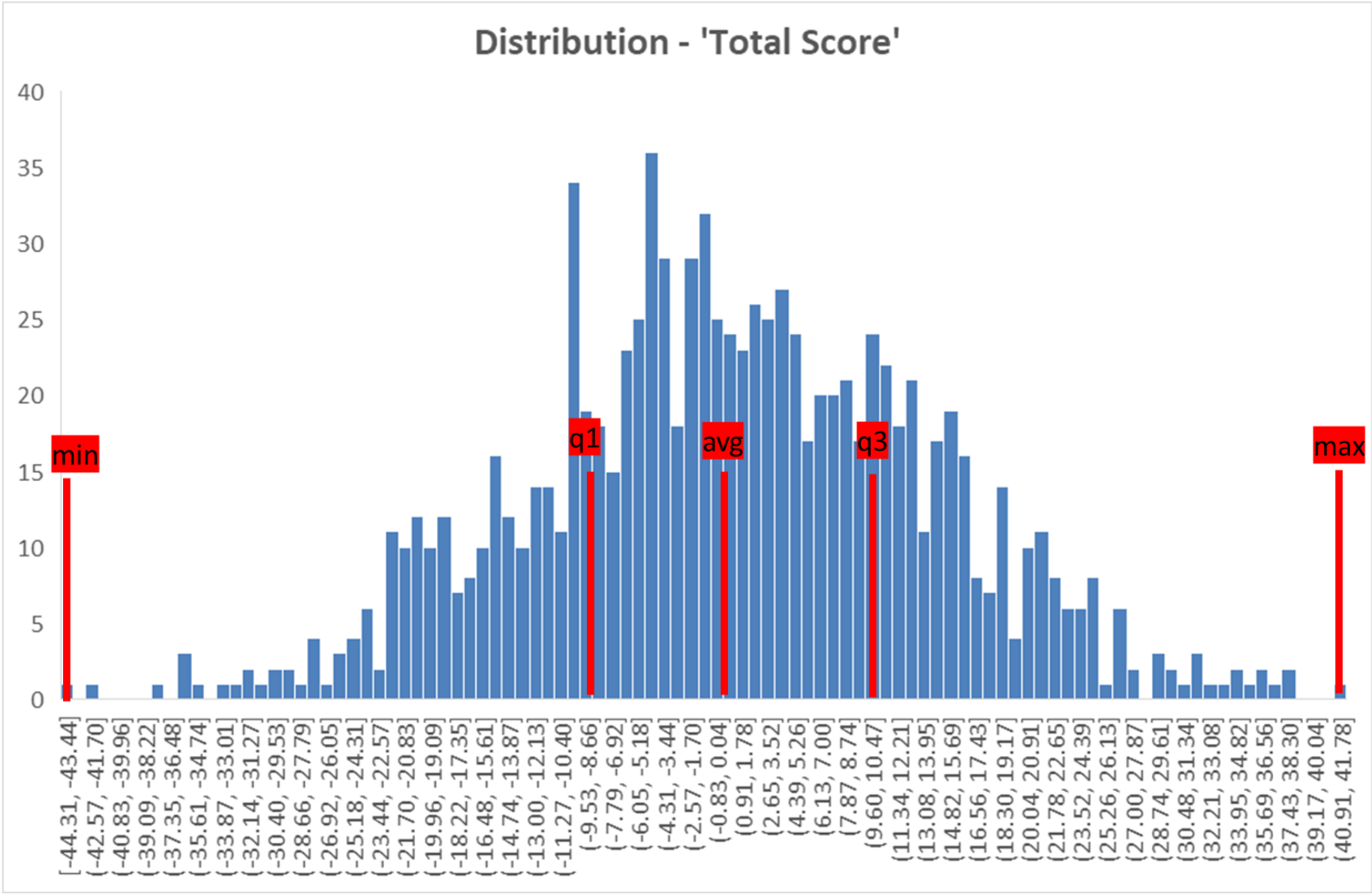
SYNTHETIC DATA GENERATOR

LCA DATA
Statistics:

- Minimum
- 2° Quartile
- Mean
- 3° Quartile
- Maximum



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AI-benchmarking/self assessment and analytics platform

- Trains on synthetic datasets and data from use-cases
- Allows users to compare their cases with real and synthetic cases
- The user can upload their own case (or cases) and perform the benchmarks indicated in the first two points.

- The user can now select a case as «reference case» (e.g. case 1 feather meal, fertilizer) and compare it with other cases (e.g. other feather meal cases)
- Allows the user to benchmark a case against the statistically significant cases (based on total scores) from the simulated data (five cases representing the max, min, average, cuartiles)

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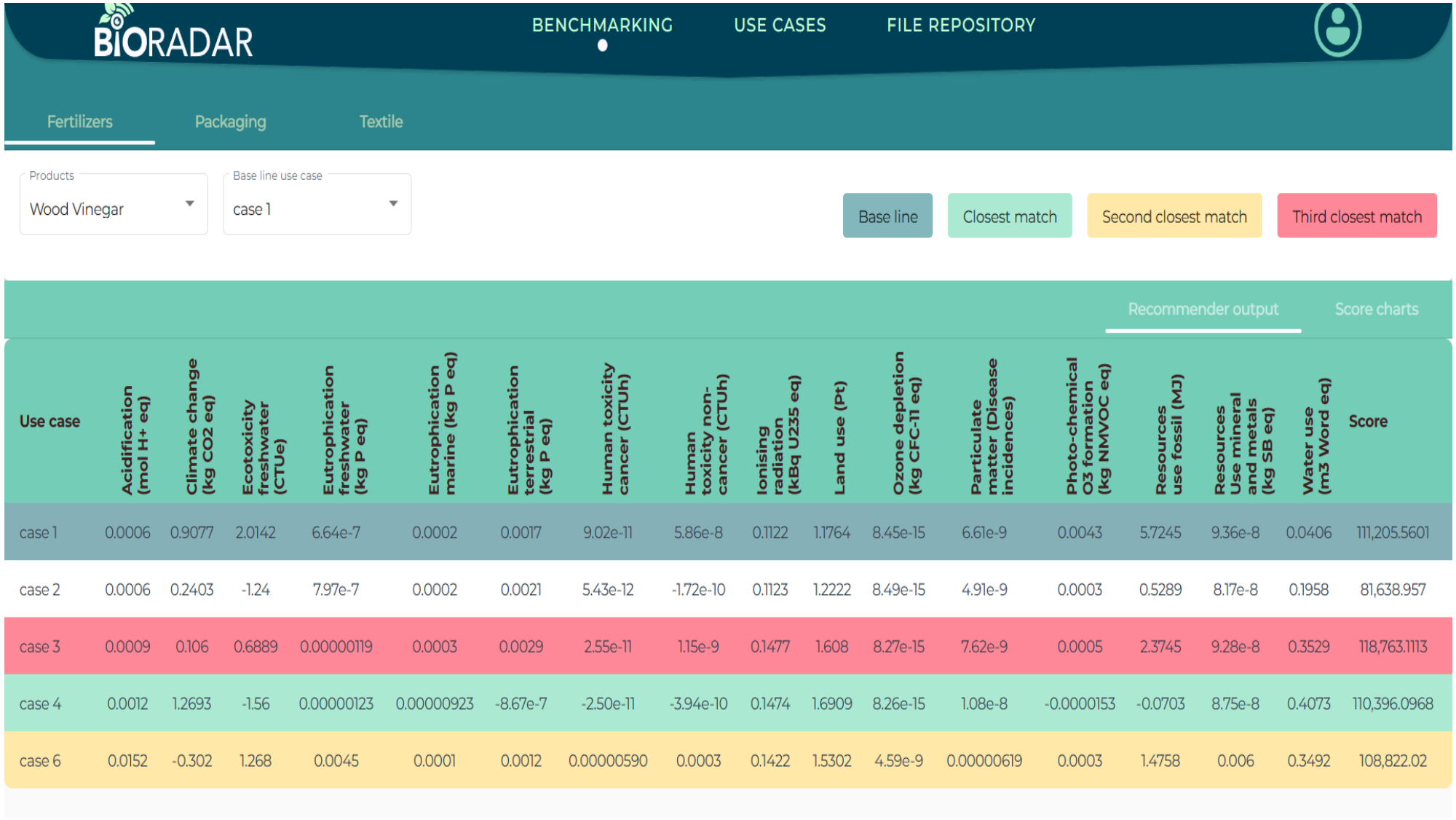
BENCHMARK of one or more CASES with a REFERENCE CASE



Use case	Acidification (mol H+ eq)	Climate change (kg CO2 eq)	Ecotoxicity freshwater (CTUe)	Eutrophication freshwater (kg P eq)	Eutrophication marine (kg P eq)	Eutrophication terrestrial (kg P eq)	Human toxicity cancer (CTUh)	Human toxicity non-cancer (CTUh)	Ionising radiation (kBq U235 eq)	Land use (Pt)	Ozone depletion (kg CFC-11 eq)	Particulate matter (Disease incidences)	Photo-chemical O3 formation (kg NMVOC eq)	Resources use fossil (MJ)	Resources Use mineral and metals (kg SB eq)	Water use (m3 Word eq)	Score
case 1	0.0006	0.9077	2.0142	6.64e-7	0.0002	0.0017	9.02e-11	5.86e-8	0.1122	1.1764	8.45e-15	6.61e-9	0.0043	5.7245	9.36e-8	0.0406	111,205.5601
case 2	0.0006	0.2403	-1.24	7.97e-7	0.0002	0.0021	5.43e-12	-1.72e-10	0.1123	1.2222	8.49e-15	4.91e-9	0.0003	0.5289	8.17e-8	0.1958	81,638.957
case 3	0.0009	0.106	0.6889	0.00000119	0.0003	0.0029	2.55e-11	1.15e-9	0.1477	1.608	8.27e-15	7.62e-9	0.0005	2.3745	9.28e-8	0.3529	118,763.1113
case 4	0.0012	1.2693	-1.56	0.00000123	0.00000923	-8.67e-7	-2.50e-11	-3.94e-10	0.1474	1.6909	8.26e-15	1.08e-8	-0.0000153	-0.0703	8.75e-8	0.4073	110,396.0968
case 6	0.0152	-0.302	1.268	0.0045	0.0001	0.0012	0.00000590	0.0003	0.1422	1.5302	4.59e-9	0.00000619	0.0003	1.4758	0.006	0.3492	108,822.02

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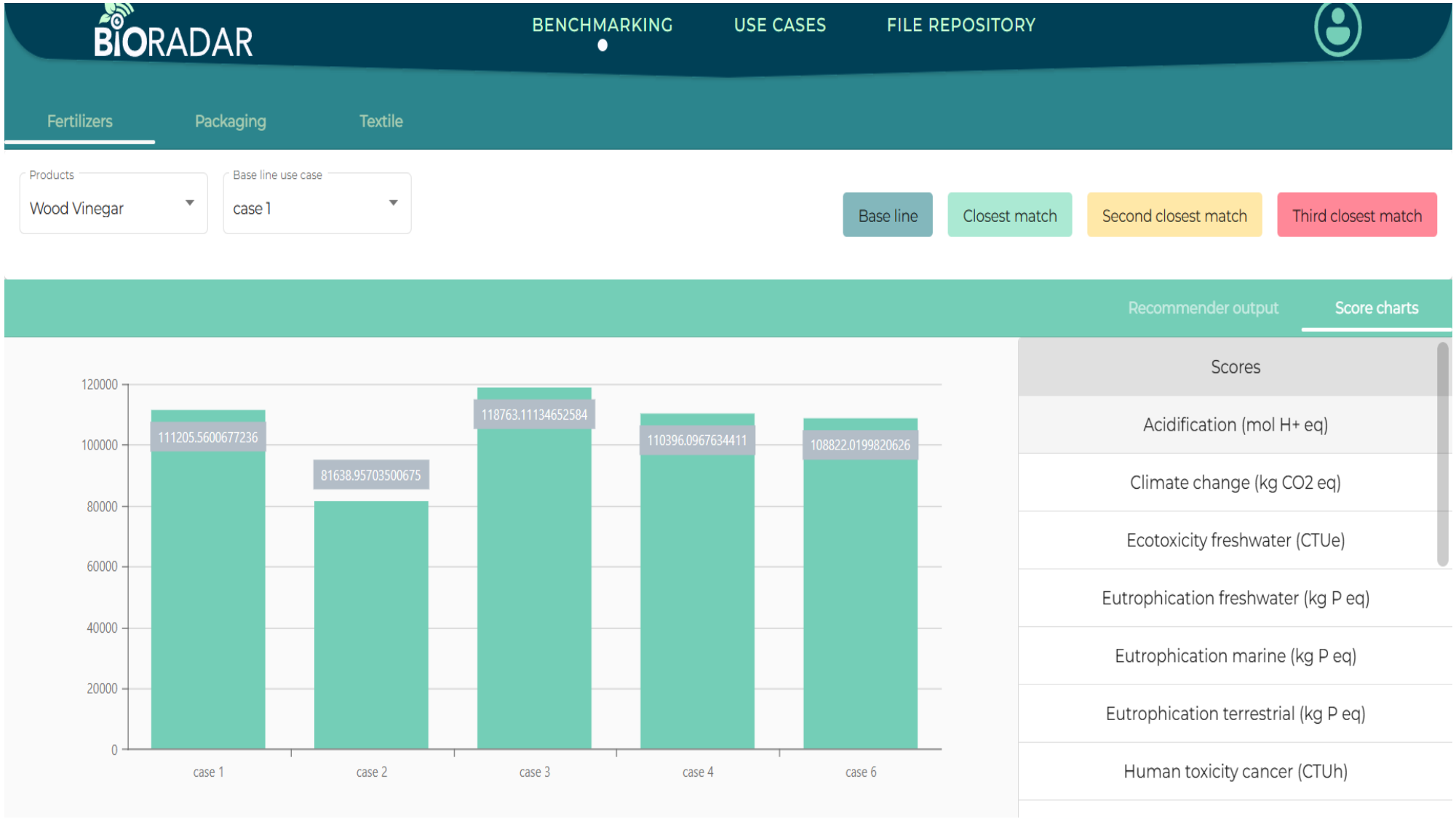
BENCHMARK of one or more CASES with a REFERENCE CASE



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BENCHMARK of one or more CASES with a REFERENCE CASE

BIORADAR

BENCHMARKING USE CASES FILE REPOSITORY

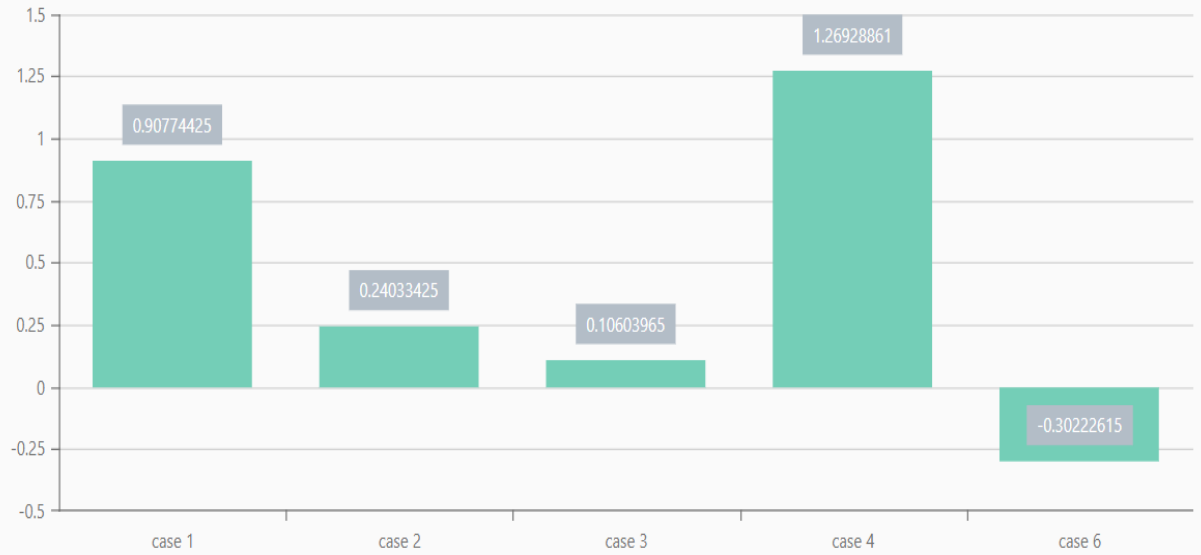
Fertilizers Packaging Textile

Products: Wood Vinegar

Base line use case: case 1

Base line | Closest match | Second closest match | Third closest match

Recommender output | Score charts



Scores
Acidification (mol H+ eq)
Climate change (kg CO2 eq)
Ecotoxicity freshwater (CTUe)
Eutrophication freshwater (kg P eq)
Eutrophication marine (kg P eq)
Eutrophication terrestrial (kg P eq)
Human toxicity cancer (CTUh)

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AI DATA ANALYTICS – *next steps*

Advanced data analytics on LCA use case data

Clustering and decision tree

- The user selects a set of data, then chooses the «clustering» option.
- The clustering clusters the data into the optimum number of clusters
- The user can inspect the case to cluster assignments

This approach solves a key issue, *labelling the raw data for supervised learning*, by using the cluster id as the class label

- Next, the user chooses the «decision tree» option.
- The decision tree is a supervised machine learning method which uses the cluster ids as training labels.
- The user can inspect the decision tree to see the rules generated for each cluster.

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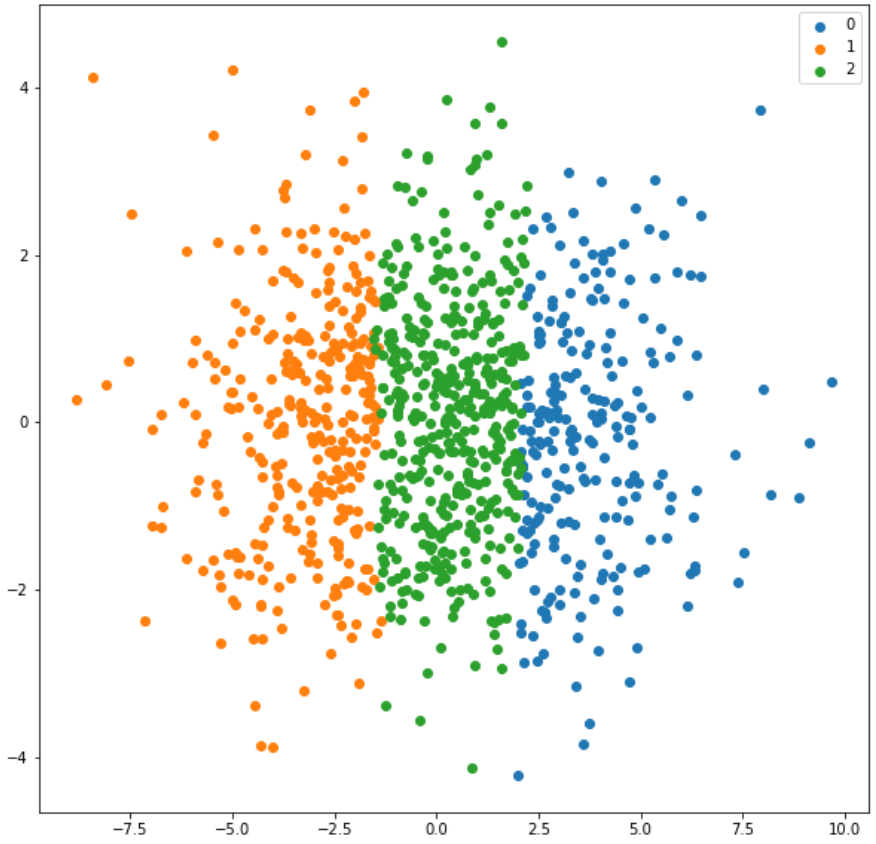
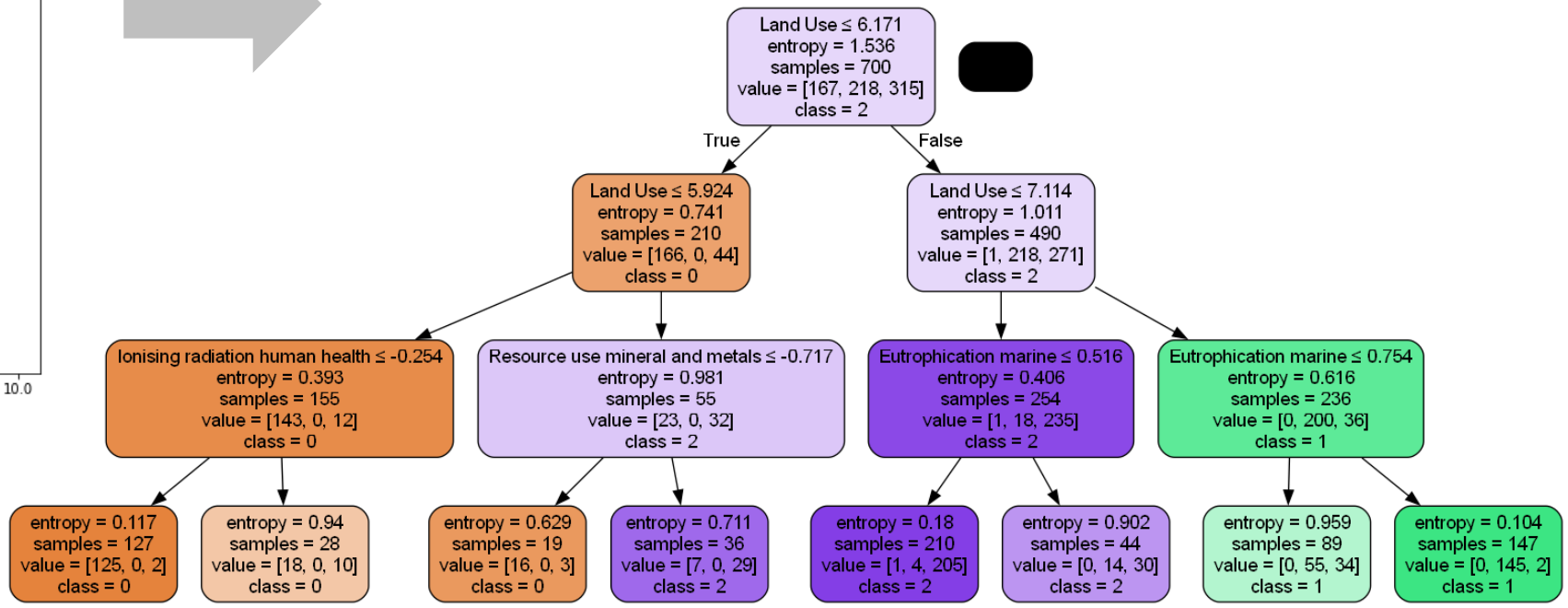
AI DATA ANALYTICS – next steps

Clustering



Decision Tree



The platform will be accessible to general users at the end of 2025

@

https://bioradar.iris-eng.com

Thank you !

Contact:

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