SustAId — *User Guide*

Welcome to Sust*AI*d, an AI-based, design-driven tool developed as part of a master's thesis at Politecnico di Milano.

SustAId aims to assist fashion designers in the process of sustainable material selection, combining artificial intelligence, to provide informed, data-driven recommendations that support conscious material choices, with design-oriented thinking in the design process.

The tool is designed to make sustainable material selection more accessible, understandable, and actionable to fashion designers. Through its curated material database and AI assistant, SustAId provide guidance, insights, and recommendations that help designers make informed decisions.

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1. Accessing SustAId

Follow these steps to access the app.

1. Download SustAId from https://github.com/alessiavittori/sustAId/releases
2. Save it in your *Downloads* folder.
3. Once downloaded, open the app from your device.
4. To access the app, no registration is required, but you will need to login to your OpenAI account (or create one if you don't have it) to use the AI assistant.

⚠ DISCLAIMER: If the opening doesn't succeed on the first try, it's because your pc doesn't recognize SustAId since it's been downloaded from the web and does not have a Developer ID Certificate since it's a beta version. To solve the issue, follow these steps:

Windows

1. Double-click *sustaid_windows.exe* to launch the application.
2. ⚠ Windows Security Warning – The first time you launch the app, Windows Defender may display a warning because the app is not digitally signed (this is normal for beta versions).
3. To proceed:
     o Click *"More info"*
     o Then click *"Run anyway"*
4. Your app should now open without issues.

macOS

1. Extract the compressed file from your Downloads folder.
2. ⚠️ macOS Security Warning — The first time you launch the app, macOS will show a *"damaged file"* error because the app is not digitally signed (this is normal for beta versions).
3. Follow these steps to solve the issue:
   o Open Terminal:
      ▪ Press *Cmd + Space* on your keyboard
      ▪ Type *terminal*
      ▪ Press *Enter*
   o A black window will open. Copy this command (all of it):

   xattr -cr ~/Downloads/sustAId.app

4. Paste the command into the Terminal window (Cmd + V)
   o Press *Enter*
   o Close Terminal window
5. Re-launch the application which will now open forever without issues:
   o Return to your Downloads folder
   o Double-click *sustAId.app* to launch the application

The app works only on laptops, both macOS and Windows, to ensure full functionality and a better visibility.

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2. Getting Started

Choose which database you want to use.

The SustAId app provides its own material database to explore and use, that loads up automatically when opening the app.

If you want, though, you can upload your own material database for SustAId to read it and adapt its features to it.

⚠️ The database must be in .csv or SQL format.

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3. Exploring the Material Database

The **Material Database** provides detailed profiles of each material included in SustAId.

How to navigate.

1. Use the *Search bar* or *Filters* to explore and sort materials.
2. Each material entry includes a detailed description *[accessible by clicking on the material name]* composed of:
   - Sustainability score
   - Material category
   - Core evaluation criteria (GHG emissions, Environmental Sustainability, Durability, Cost range)
   - Primary Applications
   - All other properties
   - Comfort level
3. After a first scan, you can choose which material add to the comparison window by clicking on the *Compare* button.

You can export [in *.csv* or *.json*] both the database and details of the single materials if needed.

⚠ FOR EXPLANATIONS ON HOW THE DATABASE WAS CREATED LOOK AT THE *Annex* AT THE END OF THE GUIDE.

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4. Comparing and Evaluating Materials

The **Compare Materials** window allows you to compare and evaluate multiple materials to support more informed decision-making. This feature is particularly useful for understanding trade-offs between material choices.

How to use.

1. Choose which material add to the comparison window by clicking on the *Compare* button in the Material Database window.
2. Compare your materials using the table for written insights, or the figures for visual comparisons.
3. Export the results of the table in [in *.csv* or *.json*], or the figures [in *.png* or *.pdf*] if needed.

The **LCA Analytics** window allows you again to compare and evaluate multiple materials, but mainly across environmental sustainability criteria.

The window offers multiple figures for visual comparison, useful to understand trade-offs between selected materials, such as:

- Material distribution by category
- GHG emissions comparison
- Water consumption comparison
- Energy consumption comparison
- Fossil fuel consumption comparison
- Sustainability score evaluation
- Multi-criteria analysis: Durability vs Environmental Sustainability
- Cost vs Sustainability score correlation
- Single material environmental profile (user can choose the material between the selected)
- Multi material environmental profile

You can export [in *.png* or *.pdf*] the figures if needed for your design process.

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5. Using the AI assistant

The **AI assistant** is the core of SustAId intelligence and interaction, designed to support you with deeper insights and informed suggestions in your decision-making.

How to use.

1. Clicking on the *AI Assistant button*, your SustAId Assistant will open in a new window.
2. To start chatting, you will need to login to your OpenAI account, or create one if you don't have it.
3. Type your question or design brief – for example, "I need sustainable alternatives to polyester for lightweight outerwear".
4. The AI will respond with suggestions based on its knowledge base on sustainability, performance, material properties, design needs, and use context.
5. You can continue the conversation by asking follow-up questions, such as deeper insights, comparison tables, material sustainability indicators, and specific material options.

You can ask to the Assistant to create file for exportation if needed for your design process.

Privacy and Data Use

SustAId does not collect or store personal design data. All interactions and feedbacks are used solely for research and improvement of the tool.

System Requirements

Windows
Windows 10 or later (64-bit)
Minimum 4 GB RAM (8 GB recommended)
100 MB disk space

macOS
macOS 10.15 (Catalina) or later
Minimum 4 GB RAM (8 GB recommended)
100 MB disk space

Technical Information

Framework: React 19 + Tauri 2
Database: Supabase (cloud)
Charts: Recharts
AI: OpenAI (GPT) / Anthropic Claude

Support
For questions or issues, contact: [alessia.vittori@mail.polimi.it]

Thank You!

Thank you for testing Sust*AI*d and contributing to this research on the integration of AI into sustainable material selection for fashion design. Your input and feedbacks will help refine the tool and advance sustainable innovation in the field.

Annex – Database information

The development of the database represented one of the most challenging yet important aspects of SustAId's functioning. It was created to overcome the limitation of users – particularly independent or emerging fashion designers – who may not have a material portfolio to upload on the platform; with the integration of a pre-existing database, users can easily explore and search fibres and materials, gaining a complete overview on the textile landscape.

The Sust*AI*d database directly integrated on the app, has been developed with the support of the custom GPT in *.csv* format and is currently hosted on Supabase.

Since the work of the SustAId GPT was not always satisfactory – although all the retrieved data was source-verified and not fabricated – manual intervention by the developer was necessary to standardize discrepancies, correct errors, and clearly define each category (both rows = materials and columns = properties) to help the AI in generating a complete, consistent, and readable database.

Textile materials and fibres

With the help of the GPT, starting from the literature review and research findings, the list of textile materials and fibres has been redacted to include as many materials as possible from those used in the fashion system.

Because data on fibres from individual manufacturers are generally difficult to obtain – particularly for free – and following the approach of Textile Exchange in its Material Market Reports and other open-access documentation on its website, except for registered materials such as Circulose®, the entries listed refer to the fibre family rather than a specific producer. For example, the entry MAT003, listed as Cotton, does not refer to a specific cotton fibre from a particular manufacturer produced under specific conditions, but rather to the generic family of cotton fibres sharing similar characteristics due to their common raw material origin.

It is for this same reason that many properties cannot be assessed with just one number, but the result will be either a range or a qualitative evaluation.

Material categories

When asked to categories the materials based on their origin, the AI was unable to provide homogeneous consistent naming. Therefore, the developer had to intervene, defining the categories in which textile materials and fibres should be clustered.

- Bio-constructed Material
- Biosynthetic Fibre
- Man-made Cellulosic Fibre
- Man-made Protein Fibre
- Natural Animal Fibre
- Natural Plant Fibre
- Natural Polymer
- Next-gen Recycled Fibre
- Non-fibre Material
- Recycled MMCF
- Recycled Natural Animal Fibre

- Recycled Natural Plant Fibre
- Recycled Synthetic Fibre
- Synthetic Fibre
- Synthetic polymer

Presented below is the list of materials (in alphabetic order) comprised in the database – each of one is preceded by its material ID for easier classification and readability of the database – and the categories they belong to.

Material ID	Material name	Material Categories
SUSTAID_001	Acetate	Man-Made Cellulosic Fibre
SUSTAID_002	Acrylic	Synthetic Fibre
SUSTAID_003	Alpaca	Natural Animal Fibre
SUSTAID_004	Angora (Rabbit)	Natural Animal Fibre
SUSTAID_005	Bamboo Viscose	Man-Made Cellulosic Fibre
SUSTAID_006	Banana Fibre	Natural Plant Fibre
SUSTAID_007	Bio-based TPU	Biosynthetic Fibre
SUSTAID_008	Biofabricated Cellulose	Man-Made Cellulosic Fibre
SUSTAID_009	Biofabricated Spider Silk	Man-Made Protein Fibre
SUSTAID_010	Bio-PA	Biosynthetic Fibre
SUSTAID_011	Bio-PERT	Biosynthetic Fibre
SUSTAID_012	Bio-PTT	Biosynthetic Fibre
SUSTAID_013	Camel Hair	Natural Animal Fibre
SUSTAID_014	Casein fibre	Man-Made Protein Fibre
SUSTAID_015	Cashmere	Natural Animal Fibre
SUSTAID_016	Circulose®	Man-Made Cellulosic Fibre
SUSTAID_017	Cotton	Natural Plant Fibre
SUSTAID_018	Cupro	Man-Made Cellulosic Fibre
SUSTAID_019	Down (Feathers)	Non-Fibre Material
SUSTAID_020	Elastane/Spandex	Synthetic Fibre
SUSTAID_021	Hemp	Natural Plant Fibre
SUSTAID_022	Jute	Natural Plant Fibre
SUSTAID_023	Kapok	Natural Plant Fibre
SUSTAID_024	Keratin fibre	Man-Made Protein Fibre
SUSTAID_025	Leather	Non-Fibre Material
SUSTAID_026	Linen (Flax)	Natural Plant Fibre
SUSTAID_027	Manila Hemp (Abaca)	Natural Plant Fibre
SUSTAID_028	Merino Wool	Natural Animal Fibre
SUSTAID_029	Modal	Man-Made Cellulosic Fibre
SUSTAID_030	Mohair	Natural Animal Fibre
SUSTAID_031	Mulberry Silk	Natural Animal Fibre
SUSTAID_032	Mycelium	Bio-constructed Material
SUSTAID_033	Natural Rubber	Natural Polymer
SUSTAID_034	Nylon/Polyamide	Synthetic Fibre
SUSTAID_035	Orange Fibre	Man-Made Cellulosic Fibre
SUSTAID_036	Organic Cotton	Natural Plant Fibre

SUSTAID_037	PHA (Polyhydroxyalkanoates)	Biosynthetic Fibre
SUSTAID_038	Piña (Pineapple)	Natural Plant Fibre
SUSTAID_039	Polyester	Synthetic Fibre
SUSTAID_040	Polyester Microfiber	Synthetic Fibre
SUSTAID_041	Ramie	Natural Plant Fibre
SUSTAID_042	Rayon/Viscose	Man-Made Cellulosic Fibre
SUSTAID_043	Recycled Cotton	Recycled Natural Plant Fibre
SUSTAID_044	Recycled Cotton (Chemical	Recycled Natural Plant Fibre
SUSTAID_045	Recycled Cotton (Mechanical)	Recycled Natural Plant Fibre
SUSTAID_046	Recycled Nylon	Recycled Synthetic Fibre
SUSTAID_047	Recycled Polyester	Recycled Synthetic Fibre
SUSTAID_048	Recycled wool	Recycled Natural Animal Fibre
SUSTAID_049	Refibra	Recycled MMCF
SUSTAID_050	Sisal	Natural Plant Fibre
SUSTAID_051	Synthetic rubber	Synthetic Polymer
SUSTAID_052	T2T (Textile-to-textile) recycled MMCF	Next-gen Recycled Fibre
SUSTAID_053	T2T (Textile-to-textile) recycled PA	Next-gen Recycled Fibre
SUSTAID_054	T2T (Textile-to-textile) recycled PET	Next-gen Recycled Fibre
SUSTAID_055	Tencel Lyocell	Man-Made Cellulosic Fibre
SUSTAID_056	Tencel Modal	Man-Made Cellulosic Fibre
SUSTAID_057	TPU	Synthetic Fibre
SUSTAID_058	Vicuña	Natural Animal Fibre
SUSTAID_059	Vinyl	Synthetic Fibre
SUSTAID_060	Viscose	Man-Made Cellulosic Fibre
SUSTAID_061	Wild Silk (Tussah)	Natural Animal Fibre
SUSTAID_062	Wool	Natural Animal Fibre

Material information

To overcome the discrepancy errors in the how the GPT searched for data on each material's properties and information, the developer again gave, the list of required information to be included along with an explanation for all of them – and a "*new*" definition for some properties that needed to be updated to ensure alignment with a design-oriented thinking and methodology.

Since it is more difficult to access open quantitative data for some families of fibres – because producers do not release them or because it is easier to measure them on semi-finished products like fabrics (e.g., abrasion resistance) – and since it is an easier language for designers – which in most cases have limited chemical knowledge – to understand, qualitative evaluation has been preferred over quantitative in assessing some of the following categories.

- **Sustainability rating** – Qualitative assessment of how sustainable the material is comprehensively across multiple sustainability and performance categories. The qualitative evaluation is, in this case, obtained with the average between the evaluation of environmental sustainability, social sustainability, governance, and durability. Materials should be rated *low*, *medium-low*, *medium*, *medium-high*, *high*, and *very high* based on the results.

- **Sustainability score** – Quantitative assessment corresponding to the *sustainability score.* Materials should be rated from 1 to 6, with *low* corresponding to 1/6, *medium-low* to 2/6, *medium* to 3/6, *medium-high* to 4/6, *high* to 5/6, and *very high* to 6/6.

- **Environmental sustainability** – Qualitative evaluation representing the material's impact on the environment throughout its lifecycle. In this context, the evaluation is obtained with the average between the values of Ghg emissions, water consumption, energy use, chemical use, fossil fuel consumption, and toxicity. Since some of these values are quantitative and expressed with numbers, the AI assistant translates them to qualitative evaluations. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Ghg emissions** – Greenhouse gas emissions produced per kilogram of material. Quantitative data expressed in kg CO2e/Kg.

- **Water consumption** – Liters of water used to produce one kilogram of the material. Quantitative data expressed in L/Kg

- **Energy use** – Megajoules of energy required to produce one kilogram of material. Quantitative data expressed in MJ/Kg

- **Land use** – Amount of land required to produce the material, usually expressed in Kg/ha, but in this context made qualitative in this context for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Chemical use level** – The quantity or intensity of chemicals used in the production of the material. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Fossil fuel consumption** – Amount of fuel required to produce and/or transport the material. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Toxicity** – Potential of the material to cause harm to humans or ecosystems. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Biodegradability** – The materials' ability (full, partial, none) to naturally decompose in the environment. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Social sustainability** – Qualitative evaluation that refers to practices and policies that support human wellbeing, equity, and social cohesion for both current and future generations. At its core, it's about creating systems and communities where people can thrive together over the long term. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Governance** – Qualitative evaluation that in fashion materials ensures that sustainability commitments (like transparency and traceability or policy and regulations compliance) aren't just aspirational statements but are backed by concrete systems that create accountability and drive real change in how fibres are grown,

processed, and used. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Durability** – Qualitative evaluation that refers to the material's resistance to wear, tear, or degradation with time. In the context of sustainable development, durability – that can be also emotional, but that unfortunately is unmeasurable – is fundamental because it reduces over consumption and extends the lifespan of garments. In this case is obtained with the average between the values of the properties that influence the performance of a fibre or material, when used to make a garment: abrasion resistance, chemical resistance, tensile strength, temperature resistance. Since some of these values are quantitative and expressed with numbers, the AI assistant translates them to qualitative evaluations. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Tensile strength** – Maximum stress the material can withstand while being stretched. Quantitative data expressed in MPa.

- **Abrasion resistance** – The material's ability to resist surface wear from friction. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Chemical resistance** – How well the material withstands exposure to chemicals without degrading. Qualitative evaluation for easier data retrieving and understanding. Materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6).

- **Moisture absorption** – The material capacity to absorb and retain moisture. Qualitative evaluation for easier data retrieving and understanding, materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6), along with quantitative assessment expressed in percentage.

- **Temperature resistance** – The range of temperatures the material can endure without damage. Quantitative data range expressed in °C.

- **Elasticity** – Ability of the material to return to its original shape after stretching or deformation. Qualitative evaluation for easier data retrieving and understanding, materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6), along with quantitative assessment expressed in percentage.

- **Dyeability** – Ease with which the material can be dyed or colored. Qualitative evaluation for easier data retrieving and understanding, materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6), along with quantitative assessment expressed in percentage.

- **Comfort level** – Qualitative assessment of how comfortable the material feels to wear. Evaluation through little explicative sentences for easier understanding when asking the AI assistant suggestions.

- **Cost range** – Typical range price of the material per unit. Quantitative range data usually expressed in $/Kg.

- **Cost volatility** – How much the material price fluctuates over time. Qualitative evaluation where materials should be rated *low* (1/6), *medium-low* (2/6), *medium* (3/6), *medium-high* (4/6), *high* (5/6), and *very high* (6/6), along with quantitative assessment expressed in percentage.

- **Primary applications** – Primary and more usual applications of a material in the fashion and textile industry. Evaluation through little explicative sentences for easier understanding when asking the AI assistant suggestions.

- **Main challenges** – Main sustainability challenges the materials undergoes. Evaluation through little explicative sentences for easier understanding when asking the AI assistant suggestions.

- **Key opportunities** – Main opportunities the material offers with its use. Evaluation through little explicative sentences for easier understanding when asking the AI assistant suggestions.

The update of the database is a responsibility of the developer who will periodically (approximately every 3 or 6 month) instruct the GPT to repeat the research to update some data, or identify new materials missing in the current list, and will check the results to prevent unwanted errors or discrepancies.

The developer has used only free open data from selected sources to instruct the GPT and create the database. For more information about the database please contact alessia.vittori@mail.polimi.it