

User Guidance

SECTOR NETWORK TUEWAS

Transport, Environment, Energy,
Water in Asia

Distribution System Operation - Toolbox for Practitioners

Developed under a dedicated Task Force of the TUEWAS Energy Working Group

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1. Introduction

Distribution System Operators (DSOs) are responsible for distributing energy to the final consumers. They typically own and operate the grid infrastructure that connect the transmission network to the final consumers of electricity.

Over the last years, technological advances in automation and increased digitalisation have opened up new avenues to optimising energy system planning, operations and maintenance - especially for those with high shares of intermittent and distributed energy generation - and power system protection. In the years to come, as more and more countries move towards higher levels of digitalisation and automation, the role of DSOs is going to significantly change and not only their investment strategies and organisational set-up, but also knowledge and skills of staff and teams will need to evolve with technological progress.

Although relevant know-how and tools to help DSOs to adapt to these new developments exist, they are not easily accessible. Within GIZ, individual projects usually mainly focus on their partner organisations and knowledge management is, therefore, also mostly limited to the project level.

Against this background, members of the Transport, Environment, Energy and Water in Asia Network (TUEWAS) Energy Working Group (GIZ India, Nepal and Viet Nam) established a task force to harness the collective power of the knowhow gathered at individual project level and support the collection of content for the development of a Toolbox that shall help improve the capacities of distribution grid operators to operate modern-day grid networks across Asia. Further, it is expected that future GIZ projects in Asia will increasingly support DSOs. Therefore, the toolbox will be a valuable resource for GIZ, as well. The specific objectives and beneficiaries of the Toolbox are defined in Section 2. Currently, TUEWAS connects over 50 projects across 16 countries in the fields of transport, environment, energy and water.

2. Objectives and Main Characteristics of the Toolbox

The **overarching objective** of the Distribution System Operation Toolbox for Practitioners (hereafter referred to as “the Toolbox”) is to be a repository for state-of-the-art knowledge and know-how that contributes to increasing the capacity of distribution grid operators to operate state-of-the-art distribution grids in an efficient and sustainable manner. More than that, the Toolbox aims to increase the technical capacity and, by extension, the interest of electricity network operating companies to absorb and distribute variable renewable-energy-based electricity and, thereby, contribute to more sustainable, robust, and climate-friendly energy systems. The Toolbox is particularly expected to support GIZ country projects supporting DSOs in Asia and beyond to learn from each other, use each other’s knowledge products and to identify and replicate promising approaches that can be integrated in the design of energy distribution sector support measures.

Direct beneficiaries and targeted end-users of the Toolbox are distribution system operators (DSOs) in TUEWAS countries and beyond. GIZ and consultancies or other institutions specialised in providing technical assistance, training and/or services to DSOs are also part of the target audience of the Toolbox. The improved capacities of the grid operators will also indirectly benefit other energy sector stakeholders that interact with them within the energy system, such as transmission grid operators, and private sector stakeholders.

3. Toolbox Description, Structure and Contents

3.1. Overview

The Toolbox compiles and makes available a library of relevant documents through a user-friendly interface, including studies, scientific articles, guidelines and other relevant files. A category-based folder structure is backed by a database that maps the folder structure, allowing the end-user to easily find, add and delete files.

The excel-based tool for download is not built to be continuously updated. While the user has the option to expand the library of the Toolbox on their own device, the original Toolbox itself will not be changed.

The web-based toolbox on Energypedia allows to upload new content and to remove obsolete or outdated content on a rolling basis, both by users and by Energypedia.

3.2. Toolbox Download

The Toolbox is available for download on several platforms, including on the [Energypedia platform](#). The download file is a zip file that contains all the elements of the Toolbox, as described in the next Section. It is recommended to users to update Adobe Acrobat before using the tool, as older versions might lead to errors when saving or opening entries that have a file. For this, in Adobe Acrobat¹, select Help>Check for updates. Install updates.

3.3. Folder Structure

The folder structure allows the storing of files according to categories. Eight categories have been defined in the current version of the Toolbox (Figure 1). Each file is assigned one main category (which also determines in which folder the file is stored). With the use of key words, which are defined for each category (Figure 1), the search options can be expanded beyond the main categories. This will be further detailed in Section 3.4.2.

¹ In Adobe Acrobat, not in Acrobat Reader.

Figure 1 – Categories and Key Words of the Toolbox

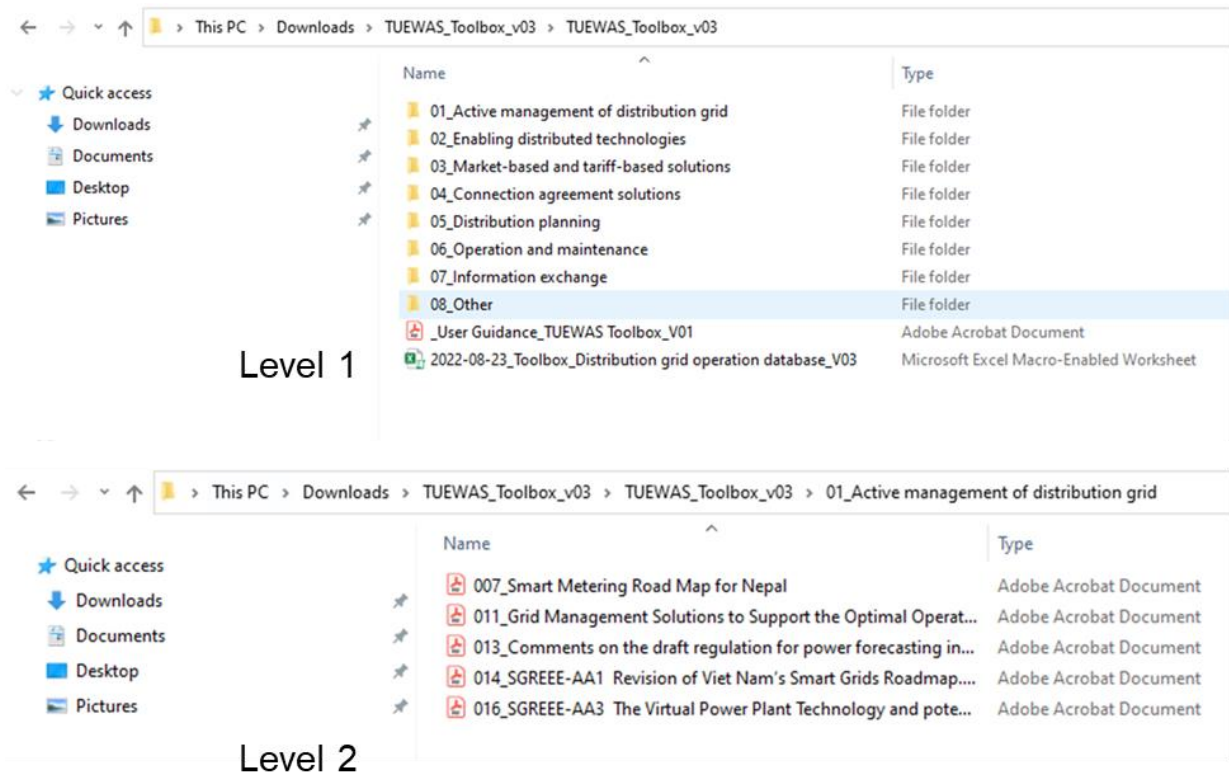
Categories	Keywords
Active management of distribution grid	DERMS
	Monitoring solutions
	Control solutions
	Congestion management
	Forecasting
Enabling distributed technologies	Smart grids (AMI, smart meters, ...) and increased digitalisation
	Battery energy storage systems
	Electric vehicles
	Distributed generation (solar)
	Distributed generation (small hydro)
	Distributed generation (others)
	Mini/micro-grids (when interconnected)
Market-based and tariff-based solutions	Inverter-specific aspects
	VPP and aggregators (market integration of DERs)
Connection agreement solutions	Demand response
	Technical requirements for connection (grid codes, standards)
	Interconnection application procedures
Distribution planning	Compliance mechanisms
	Distribution planning/ Electrification master plan
	Grid simulation studies
	Protection coordination and adjustments
	Centralised information database (e.g. DER register, GIS, ...)
Operation and maintenance	Disaster management and resilience
	Asset management
	Distribution transformer maintenance
	Distribution transformer health monitoring
Information exchange	Information and operational technology integration (IT-OT)
	Interoperability and communication protocols
	Cyber security
Other	TSO and DSO increased coordination and data exchange
	User defined

NOTE

The Toolbox Database (excel document) must be located in the same folder as the category folders 01-08, as available in the downloadable version of the toolbox and shown in Figure 2.

The folder structure itself (Figure 2) consist of two levels. The first level contains the category-based folder structure (folders numbered 01 to 08), the excel-based Toolbox database, as well as the User Guidance document. Within each of the folders (second level), all files that correspond to the particular main category are stored.

Figure 2 – Folder Structure of the Toolbox



3.4. Excel-based Toolbox Database

The Toolbox Database is an excel document that uses macros to allow the user to easily search for documents that have been deposited in the filing system. It also allows the user to add or delete files to the database and folder structure and to make edits to individual database entries.

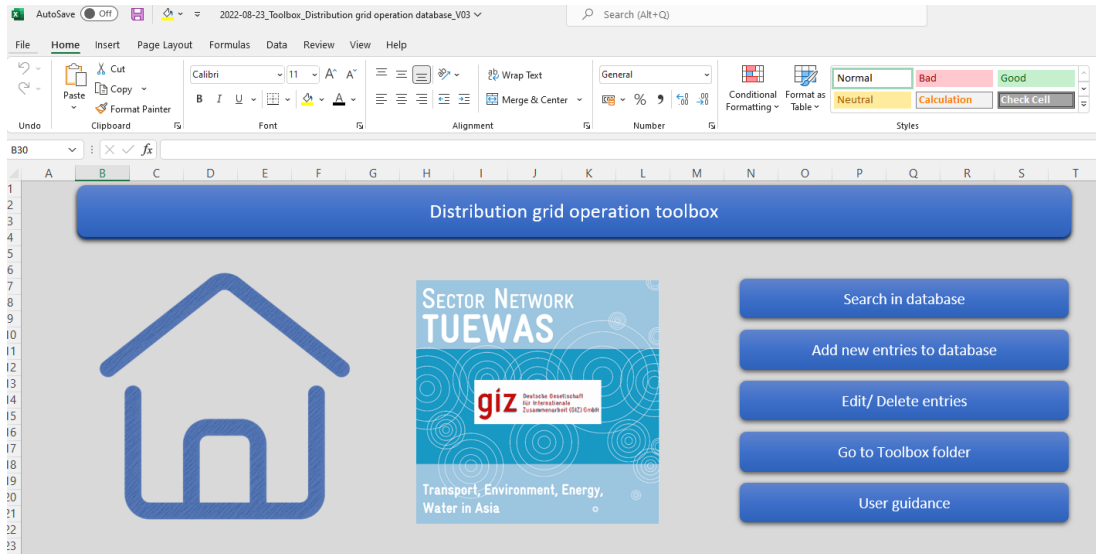
NOTE

Content must be enabled when opening the excel document for macros to work!

The excel file consists of three sheets: 1) Home, 2) Search, and 3) Database.

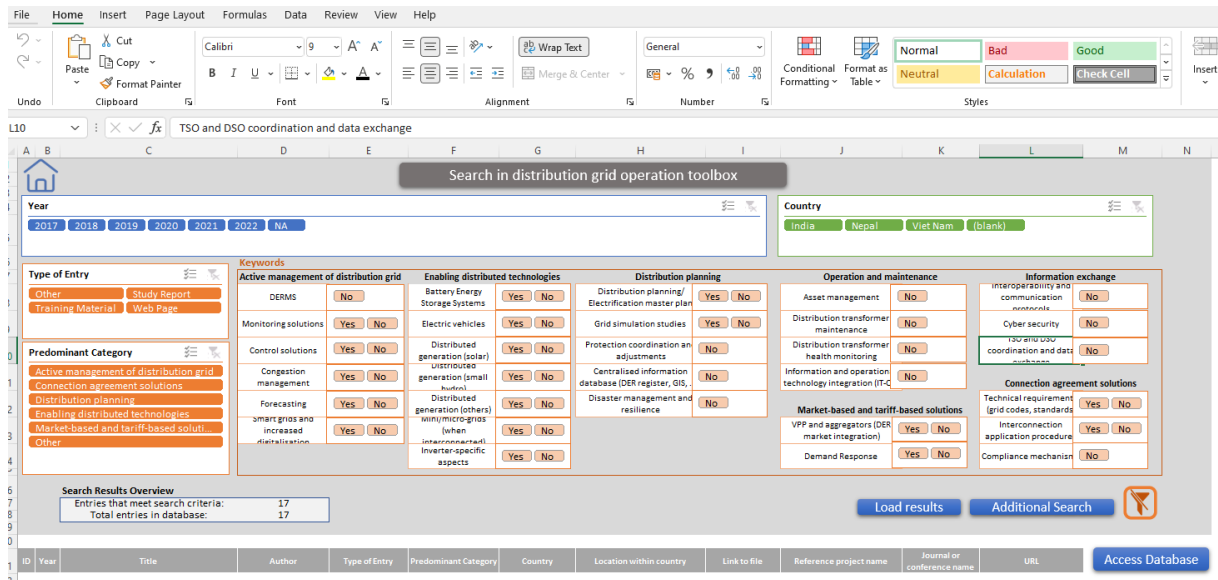
The Home sheet (Figure 3) provides a description of the Toolbox, as well as a link to the TUEWAS website. Next to that, the Home sheet mainly acts as an interface that allows the user to access the different sheets of the database, as well as the folder structure.

Figure 3 – Home Sheet of the Toolbox



The Search sheet (Figure 4) consists of a dashboard of slicers that allow for a user-friendly filtering of the database. Slicers are available for categories, keywords, year of publication, country and type of material. How to conduct a search is further detailed in Section 3.4.2.

Figure 4 – Search Sheet of the Toolbox



The Database sheet contains the entire list of documents that have been deposited in the filing system and provides detailed information about each file, including title, author, publication year, type of entry, category, country, an abstract, keywords, etc. The database sheet also includes selected slicers, in case the user wants to conduct a search in the Database sheet, directly.

Figure 5 – Database Sheet of the Toolbox

ID	Year	Title	Author	Type of Entry	Predominant Category	Country	Location	Link to file	Reference project name	Journal or conference name	URL
1	2019	Impact assessment of large scale integration of electric vehicle charging infrastructure in the electricity distribution system	PRDC, pManifold	Study Report	Enabling distributed technologies	India		Link to File	Rooftop Solar Photovoltaic 2 (RTPV 2), Indo-German Energy Programme (IGEN)		URL
2	2017	Analysis of Indian Electricity Distribution Systems for the Integration of High Shares of Rooftop PV	Energynautics GmbH, GSES India	Study Report	Distribution planning	India	Delhi and Bhopal	Link to File	Integration of Renewable Energies in the Indian Electricity System (I-RE), Indo-German Energy Programme		URL
3	NA	Draft Roadmap for Capacity Building of Distribution Utilities in India	Feedback Infra Pvt. Ltd., India; Energypeople, UK	Study Report	Other	India		Link to File	Energy transition in India with distribution companies (DISCOMs)		
4	2020	Proposed Financial Product: Loan to DISCOM (Grid-Connected Solar Powered Agriculture Pump)	Deloitte Touche Tohmatsu India LLP	Other	Enabling distributed technologies	India		Link to File			
5	2020	Explanatory Video of Proposed Financial Product: Loan to DISCOM (Grid-Connected Solar Powered Agriculture Pump)	Deloitte Touche Tohmatsu India LLP	Other	Enabling distributed technologies	India		Link to File			
6	2020	Enhancing ROI in Commercial and Industrial Rooftop Solar & Stabilizing the RE Dominated Utility Grid Through Storage	Indo-German Energy Forum	Web Page	Enabling distributed technologies	India					URL
7	2018	Smart Metering Road Map for Nepal	Asian Development Bank	Study Report	Active management of distribution grid	Nepal		Link to File	Power Transmission and Distribution Efficiency Enhancement Project		URL

3.4.1. Toolbox Navigation

From the Home sheet the user can access all the main functions of the Toolbox. The search, add and edit/delete functions are further detailed in Section 3.4.2, 3.4.3 and 3.4.4, which are written in instruction style to be used in the User Guidance. From the Home sheet, the user can also open the folder structure directly and open the User Guidance pdf document, in case they need further information on how to use the Toolbox.

Figure 6 – Navigation from the Home Sheet of the Toolbox

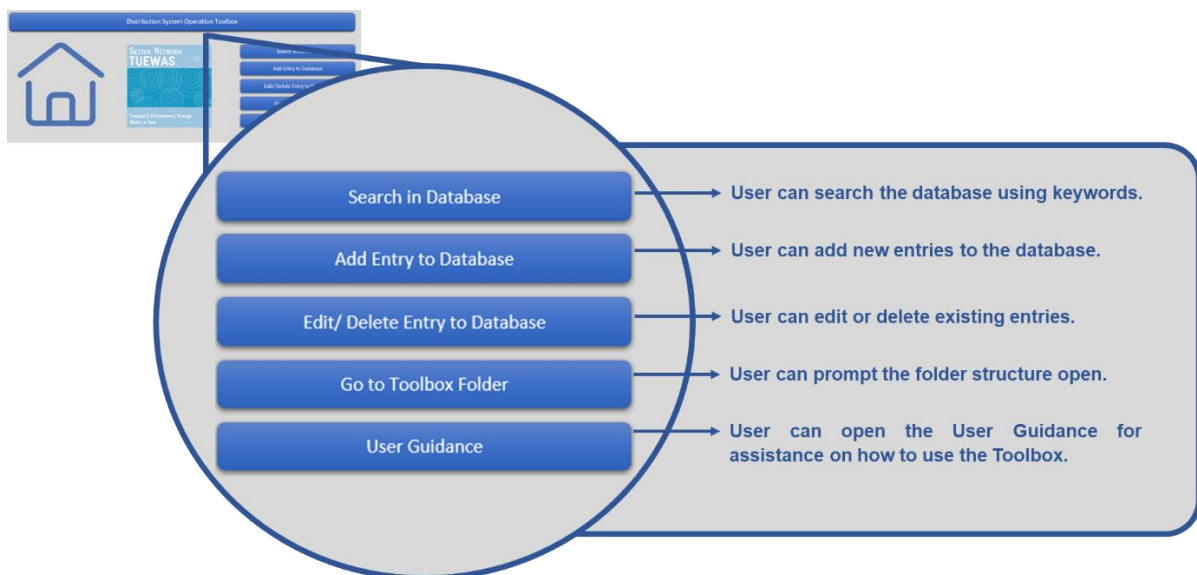
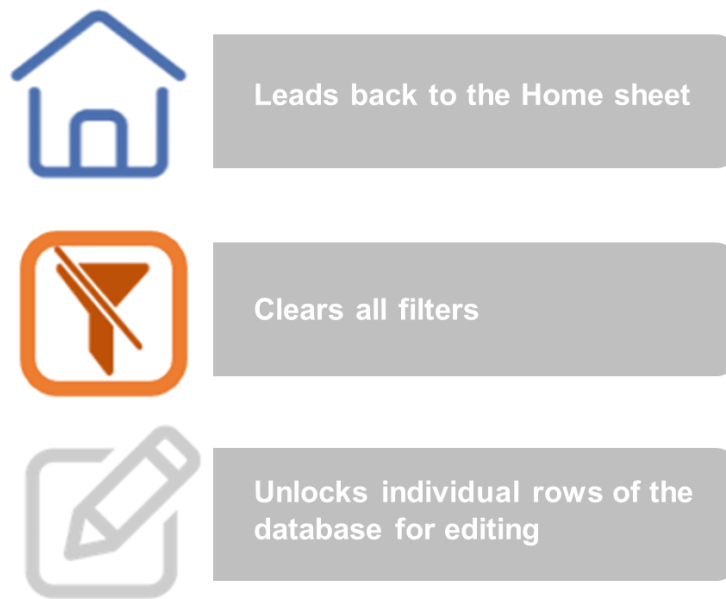


Figure 7 provides an overview of navigational and other buttons that can be found within the Toolbox, as well as their function.

Figure 7 – Functional Buttons of the Toolbox

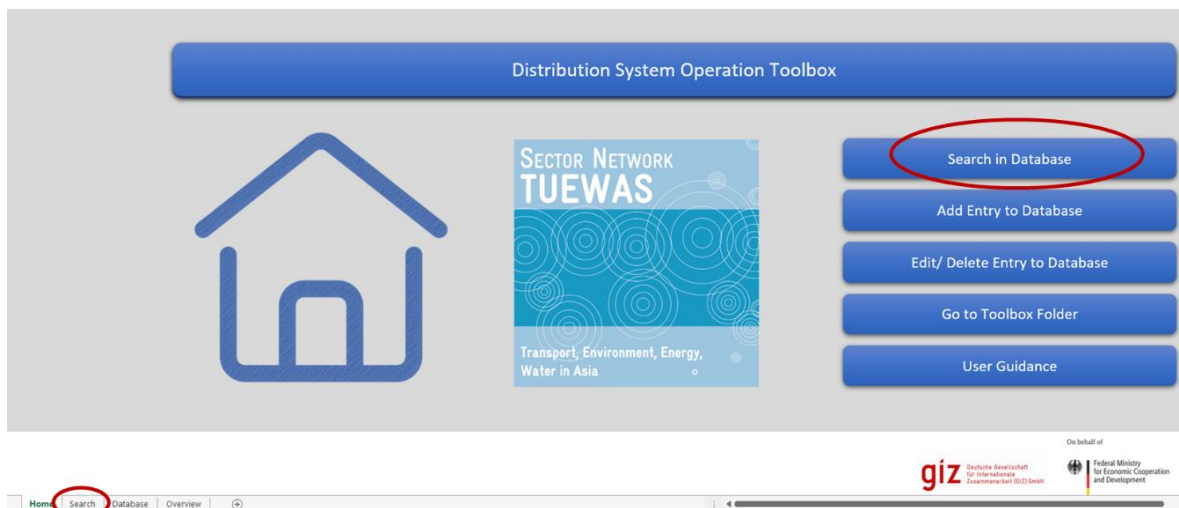


3.4.2. Conducting a Search

Go to the Home sheet.

Click on “Search in Database” (Figure 8), upon which the user is redirected to the Search sheet. You can also go directly to the Search sheet by manually clicking on the sheet tab at the bottom of the excel.

Figure 8 – Opening the Search sheet



In the Search sheet you can filter entries from the database by using the slicers (

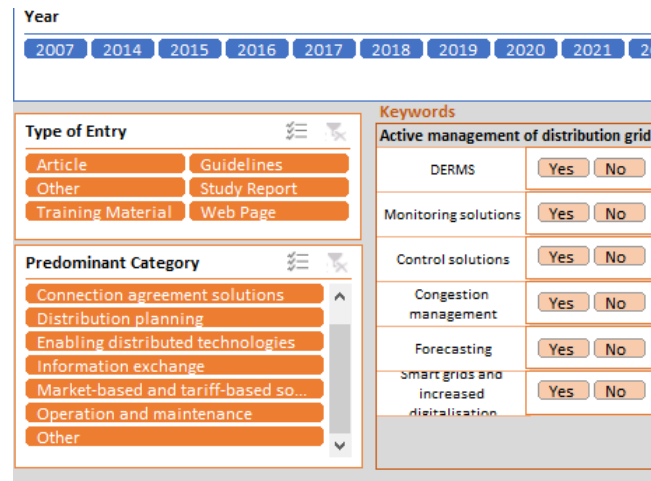
Figure 9). There are five types of slicers: 1) Year, 2) Country, 3) Type of Entry, 4) Main Category and 5) Keywords. You can choose which way to best use the slicers to find what you are looking for, i.e., there is no need to use all of them.

NOTE

To select or remove from selection more than one filter criteria within the same slicer (e.g., search database for both “Article” and “Guidelines”), hold Ctrl key and click on the slicer criteria. Grey or white colouring represent those not selected.

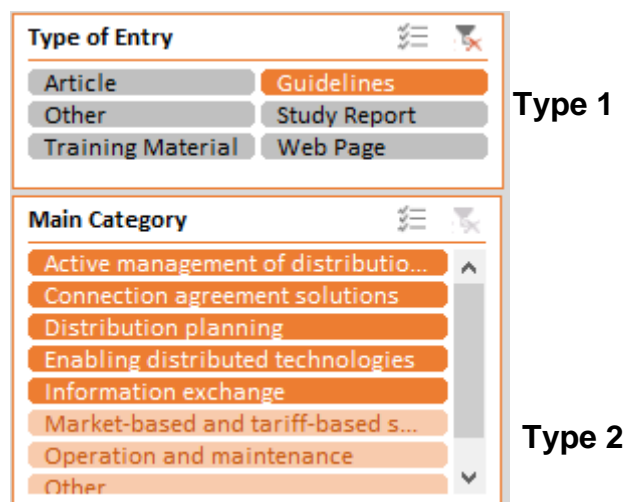
Each new slicer selected for filtering will add to the previously selected filtering criteria (slicers). For example, by selecting Viet Nam in the country slicer, as well as “Control solutions” and “Battery energy storage systems” in the keyword slicers, the filtered results will be those for Vietnamese sources that are marked with both keywords.

Figure 9 – Slicers in the Search sheet



Upon filtering, the user will notice two types of slicer colour changes. The **Type 1** is to indicate that one or more options have been selected in each activated slicer. Selected options keep their original slicer colour, whereas non selected options (within an activated slicer) will turn grey (or white in case of slicers for keywords). The second colour change (**Type 2**) is when the colours within the slicer keep the original main background colour (i.e., do not turn grey or white) but are marked in a lighter tone. This means that with the already applied filters, there are no results for that specific criteria. In the example shown in Figure 10, when selecting “Guidelines” in the “Type of Entry” slicer, the non-selected options in that slicer turned grey (Type 1), whereas a few options in the “Main Category” slicer changed to a lighter colour (Type 2). This means that there are no entries marked as “Guidelines” that are part of the “Operation and Maintenance” category, for example.

Figure 10 – Slicer colouring changes in the Search sheet

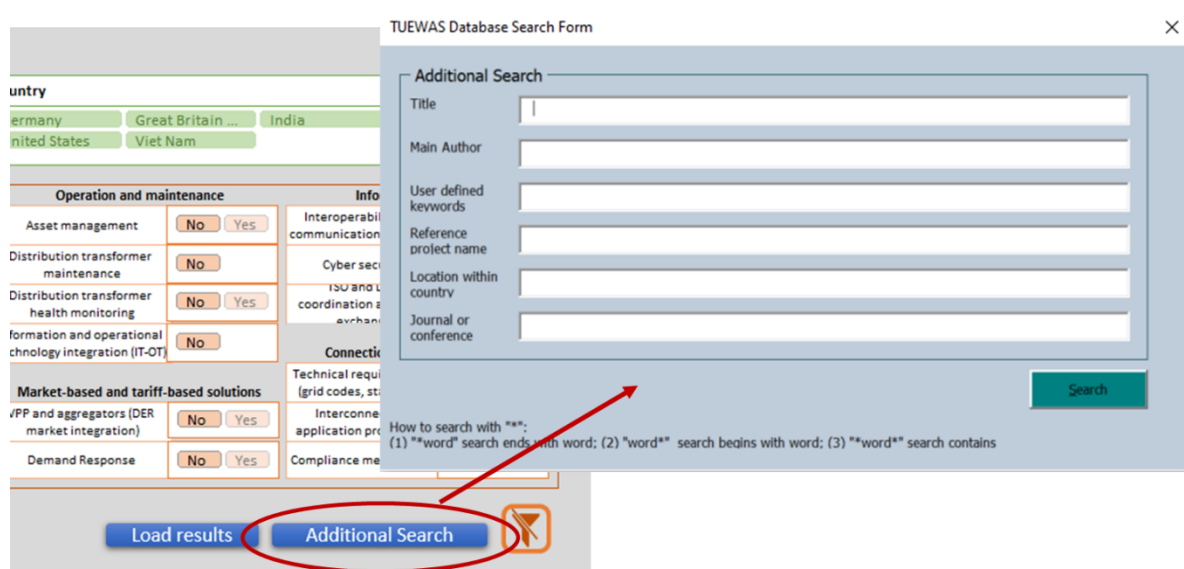


If you want to conduct a more detailed search, you can use the Search Form, which can be opened by clicking on the Additional Search button on the bottom right of the Search sheet (Figure 11). Multiple search fields filled in the Search Form will create “AND” conditions. For example, writing “feasibility” in the title field and “Smith” in the author field will search the database for entries that meet both criteria.


It is recommended to use the special character “*” in the search form to provide more flexibility when filtering (similar to the use of “...” in written texts). For example, in the title field, filter titles that contain the words “feasibility study” in a specific position by:

- Typing “*feasibility study*” to search for titles that contain these words in any position. (Recommended).
- Typing “feasibility study*” to search titles that begin with “feasibility study”.
- Typing “*feasibility study” to search titles that end with “feasibility study”.

Figure 11 – Additional Search Form



NOTE

The Additional Search option will allow filtering in addition to the filters already selected using slicers. If you wish to perform a specific filtering using this form on all entries of the database, it is necessary to clear the slicer filters before (by clicking on the button ).

Once you are done selecting your search criteria you can see how many entries match your search criteria in the bottom left of the Search sheet and proceed to load the results by clicking on “Load results” (Figure 12).

Figure 12 – Search Results



You can either choose to open the loaded files from this search list by clicking on “Link to File” or click on “Access Database” to get more information on the filtered documents. If you click on “Access Database” you will see the same search results but have access to more detailed information about each file. To access this information, you must click on “Extra Data” in the Database sheet (Figure 13), which unhides additional data rows to the right of the sheet.

Figure 13 – Extra data

ID Number	Year	Title	Author	Type of Entry	Predominant Category	Country	Location	Link to File	Reference project name	Journal or conference name	URL
45	2020	PV Generation Hosting Capacity in Dominican Distribution Grids	Energynautics	Study Report	Distribution planning	Dominican Republic		Link to File			URL
46	2017	Do It Locally: Local Voltage Support by Distributed Generation – A Management Summary	Fraunhofer IWES	Study Report	Distribution planning			Link to File	IEA Task 14 Subtask 2		URL

3.4.3. Adding an Entry to the Database

You can expand the database by adding new files, allowing you to build your own personalised Toolbox over time.

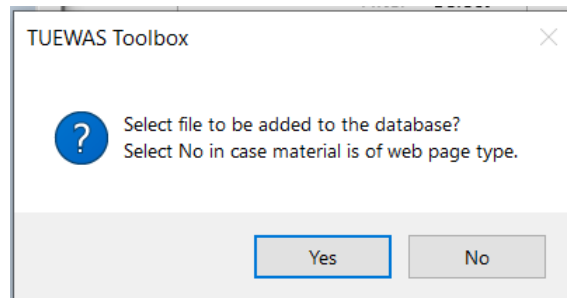
To add a new file, you must click on “Add Entry to Database” on the Home sheet, which will prompt a data entry form (Figure 14).

Figure 14 – Opening the Data Entry Form

To successfully add a new file, all fields that are marked with a star (*) must be filled in. The choice of at least one category and one keyword is obligatory and you must assign the main category, which determines in which folder the file (if you are uploading a file) will be saved. Other fields are optional. We do recommend adding as much information for each entry as possible to facilitate future filtering and use of the Toolbox. Click save to complete the data entry. Additional guidelines can be found by hovering the cursor over some of the fields.

Upon clicking on save and confirming the action of saving the entry to the database, the user will receive the message box shown in Figure 15. When selecting Yes, the user will be able to select a file from his/her computer to be copied into the toolbox (does not change the user's original file). If the user selects No, this means that there is no file to be uploaded for this specific database entry, which is usually the case for entries of the Web Page type.

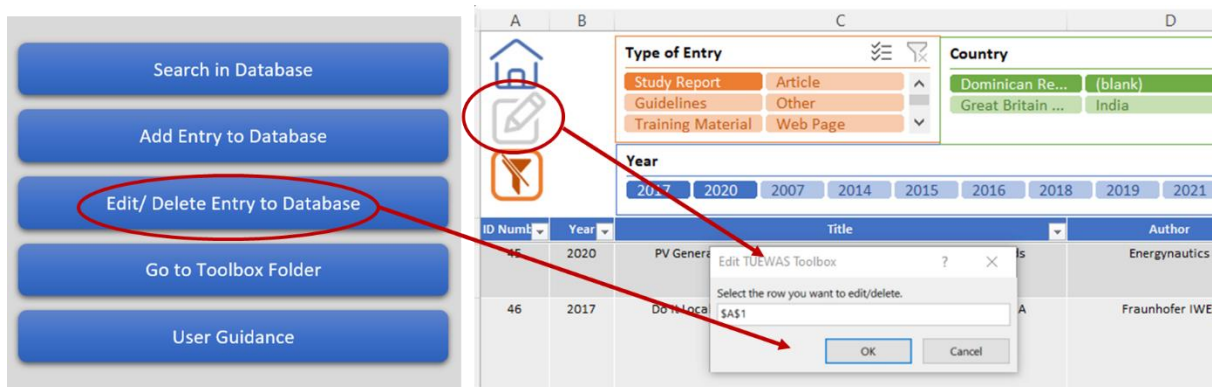
Figure 15 – Message box when entry is added with a file.




3.4.4. Editing and Deleting Entries

To edit or delete files, you can click on “Edit/Delete Entry to Database” on the Home sheet, which will direct you to the Database sheet, where the Edit Toolbox message box will be automatically prompted (Figure 16). You can also go directly to the Database sheet and click on the edit icon to prompt the Edit Toolbox box.

Figure 16 – Opening the Edit Toolbox box



To avoid accidentally editing or deleting vital information, the Toolbox only allows for editing of one row of the database at a time. You must select which row you want to edit by using the Edit Toolbox box. Click o.k. to unlock the selected row and proceed with the intended changes. You can also completely delete the entry at this point using the mouse right-click and delete option. Once you are done editing the row will be automatically locked again when selecting a new row to edit, or when the user switches to the Search or Home sheets.



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