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Instruction Manual for LCCBA Toolbox 'Quick.Calc' and 'Comparison' for Chinese Experts and Companies

by order of

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Dag-Hammarskjöld-Weg 1-5
65760 Eschborn
Federal Republic of Germany

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

prepared by

Jan W. Bleyl - Energetic Solutions

Lendkai 29
A 8020 Graz
Austria

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SOLUTIONS
JAN W. BLEYL

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Consulting team, Disclaimer, Citing, Imprint and Authors

The **consulting team** consisted of the following members:

- ✓ Mr. Jan W. Bleyl, Energetic Solutions – senior consultant and energy efficiency expert
- ✓ Mr. Ralf Gernat, Gernat Kompetenz – IT expert

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While every reasonable effort has been made to ensure the accuracy and validity of the information contained herein, the abovementioned parties of the mission team do not guarantee the accuracy hereof, nor do they purport the information contained herein to be complete or that it reflects their views.

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Imprint and Author(s):

DDI Jan W. Bleyl-Androschin, auditor, CMVP and lecturer
with support from DI Ralf Gernat, MSc – Gernat Kompetenz.

c/o: **Energetic Solutions**
A-8020 Graz, Lendkai 29
Tel.: +43 650 7992820
Email: Office@Energetic-Solutions.eu

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JAN W. BLEYL

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1 Introduction

Energy efficiency (EE) or renewable energy (RE) options typically require higher up-front investments (CAPEX) but lead to cost savings and reduced operating and maintenance costs (OPEX) over the project cycle. Not to forget positive environmental effects such as the reduction of CO_2 and other emissions. Equally important: 'Multiple Benefits of energy efficiency investments' [IEA 2014][1]. The key question is: How can decision makers be enabled to recognize and assess the long-term added value of a higher up-front investment?

Life-Cycle Cost-Benefit Analysis (LCCBA) is a method for assessing the total costs and benefits of ownership of an asset. Over an entire project-or life-cycle, it considers all monetizable benefits and costs of acquiring (investing), operating (including necessary reinvestments) up to the sale or disposal of the asset at the end of the project-cycle. A LCCBA can be applied when different project alternatives fulfill the same performance requirements but differ in initial and operating costs, have to be compared to select the one that minimizes the total costs or maximizes net savings.

In a dynamic LCCBA, project cash flows (P-CF) are determined for each revenue and cost item. Taking financing options into account allows to derive also equity (E-CF) and debt cash flows (D-CF). From these different types of cash flows (CF), economic and financial key performance indicators (KPIs) are derived. Examples of economic KPIs are Net Present Value (NPV), Internal Rate of Return (IRR) or Dynamic Payback Period (PBT). Examples for financial KPIs are CF Available for Debt Service (CFADS), Debt Service Coverage Ratio (DSCR), Loan Life Cover Ratio (LLCR) for both Project- and Equity-Cash Flows (P-CF, E-CF).

This well-grounded methodology is an excellent basis for investment decisions ('capital budgeting'). The comparison of economic and financial KPIs with a company's or institution's investment guidelines enables a decision either in favour or against a

[1] 'Multiple Benefits' on the micro or company level may encompass (but are not limited) to renovation of obsolete technical systems, reduced maintenance and repair costs, increased reliability of the systems and compliance with legal or regulatory requirements; improvement of thermal comfort in buildings and increases in productivity and quality of production.

In addition to environmental benefits, investments in EE and RE contribute to local value creation, with correspondingly positive qualification and employment effects in a future industry sector to name a few on the macroeconomic level.

certain project or the selection of the most cost-effective investment option.

The dynamic LCCBA Toolbox 'Quick.Calc' and 'Comparison' applies this concept to energy efficiency and/or energy supply investments. '**Quick.Calc**' enables the analysis of an individual energy savings or supply project. '**Comparison**' allows to compare the results and KPIS of up to three 'Quick.Calc' project alternatives.

In practice, the LCCBA Toolbox can, for example, assist in determining whether it is cost-effective to replace and existing ventilator with a high efficiency ventilator in a given time period. What is the internal rate of return of this investment (compared to other investment options known as opportunity cost)? Or whether the life-cycle cost of a photovoltaic system to self-generate electricity will be cost competitive to electricity generated by fossil fuels in a certain cost or price development scenario? And if not, how high would prices of CO_2-emissions have to be in order to achieve cost parity between the two options? What are the effects of different financing options, e.g.in the form of equity and debt capital?

The LCCBA toolbox allows to give profound answers to the questions mentioned above with comparatively little effort. Moreover, it can be a meaningful assessment and management tool to provide guidance for a variety of applications, such as:

a. **Economic and technical project management and risk assessment** => e.g. to determine sensitive parameters, minimum or maximum threshold values.
b. **Suppliers and Energy Service Companies (ESCos):** Calculation of proposals to customers.
c. **Financial engineering:** Effects of equity and debt financing shares? Need for grace periods?
d. **Project reporting** and **decision making**, e.g. to management boards, project stakeholders.
e. **Reporting, negotiations and due diligence with financiers.**
f. **Support** in **policy design**, e.g. strategy design, structuring of support programs, subsidy demand calculations up to quantitative assessments.

It is also worth noting, that LCCBAs can be applied in **various phases of the project cycle,** from initial project ideas to detailed investment grade calculation up to the operation phase and controlling, e.g.:

a. **Pre-feasibility:** Interesting? Which key parameters to focus on?

=> Support for strategy development.

b. **Detailed planning/design:** Which technical solutions to implement (e.g. higher CAPEX investment in exchange for lower OPEX)?
c. **Operation phase:** Which parameters to monitor?
d. **Controlling:** Target-performance comparison?

It is important for every area of application to always clarify the concrete question you are trying to answer with the LCCBA.

The **prerequisite for the independent use of the LCCBA Toolbox** is a basic understanding of energy management issues, including the relationship and conversion between different physical energy units (e.g. MWh, ton of oil equivalent (TOE), power, energy, operating hours ...). Understanding and interpreting the results of the LCCBA also requires a basic knowledge of energy economics and investment financing. This manual has neither the intention nor would be able to replace a textbook and own studies on the above topics. In addition, sufficient experience is required in performing calculations in Excel on a given spreadsheet (with the support of this guide).

Some further **methodological basics** for the application should be considered. The LCCBA always takes an investors perspective, which could be an ESCo, a company, a policy maker or any other type of investor. It is typically applied to assess micro-economic profitability at project level, but also so-called 'external' costs and benefits can also be modelled if required (cf. 'Multiple Benefits' concept). In principle assessments can be carried out either prospectively (=> planning) or retrospectively (=> controlling). Last but not least, it should be noted that calculation parameters and framework conditions such as project duration or price development scenarios as well as minimum KPIs are selected (not given).

The user should also be aware of the following **limitations** of the LCCBA-Toolbox and its application. The main purpose of the toolbox is to model and analyze the economic and financial characteristics of a variety of EE and RE projects. Their technical feasibility is not validated by the toolbox. It is the user's responsibility to assess whether the project's components and system can meet all requirements. The toolbox was developed with the utmost diligence and for training purposes only. It is not commercially distributed software with a support hotline. For further details on the user and non-disclosure agreement and the disclaimer, please refer to Section 2.

In general, it should be noted that any prospective economics calculation such as an LCCBA is a prognosis or projection into a more or less unknown future. In other words, it is a scenario of a possible future. Consequently, the user must be aware of opportunities, but even more so of uncertainties and risks. A sound risk management strategy is therefore advisable. In this context, the LCCBA will help to make informed management decisions based on scenarios of 'what happens, if a particular future development will occur'.

The manual documents further information about the LCCBA-Toolbox 'Quick.Calc' and 'Comparison'. It is intended for use in conjunction with a hands-on workshop as prepared and presented by GIZ and Energetic Solutions. The target audience is therefore participants of these workshops, that should use this manual as a reference. This manual is not intended as a stand-alone document. In order to fully understand the usage and functionality of the Toolbox, participation in the workshops is crucial. This also applies to the Train-the-Trainer concept. There is also a more comprehensive LCCBA assessment tool ('Detailed.Calc'), however it is not part of this license agreement and user manual.

This manual is structured as follows: A "User and Non-Disclosure Agreement, Exclusion of Liability" in section 2 is followed by an outline of IT requirements and instructions for LCCBA Toolbox file handling. Section 4 provides "General guidelines and hints on the use of Excel-based LCCBA calculations", followed by a detailed operation manual for the 'Quick.Calc' and 'Comparison' toolbox, using the example of an energy saving project. The manual ends with a short glossary and some space for participants notes.

This manual in combination with the training should enable experts to actually perform LCCBAs for their own projects. It should enable to prepare well-grounded recommendations for investment decisions and help companies and institutions to save substantial amounts of money and to generate other 'Multiple Benefits' of investments into EE and RE. And last but not least, help to relieve the heavy burden on the environment.

We wish you good luck with your LCCBA calculations and implementations of your projects! In case of questions or remarks, please feel free to contact office@Energetic-Solutions.eu or maximilian.ryssel@giz.de.

2 Software License: User and Non-Disclosure Agreement, Exclusion of Liability

The following terms and conditions apply for any use of the LCCBA Toolbox:

1. The Excel calculation Toolbox was developed with the utmost diligence possible **for training purposes only**. It is not a commercially distributed software with a support hotline.
2. **Liability** for any information or calculation results is not assumed by the organizers of the training course or the tool developer Mr. Jan W. Bleyl – Energetic Solutions. It is within the sole duty of the user to check the plausibility and correctness of the calculation results by professional verification.
3. **Non-Disclosure Agreement** (NDA)**:** The tool may be used freely to calculate projects within your company. A partial or complete distribution to third parties, no matter if free of charge or subject to charges is not permitted; nor is any commercial application of the Toolbox nor this manual.
4. **By utilizing of the tool, the user accepts this exclusion of liability, user and non-disclosure agreement** (NDA)**.** If not accepted by the user, the 'Quick.Calc' project files will not open.

The current **license agreement** (financed by GIZ) **ends on 23. May 2021.** Within the last remaining 90 days before the license expires, this will be displayed in an information box upon opening the 'QuickCalc. After the licence expiration, the Toolbox cannot be used anylonger and the project file will be closed automatically.

3 IT requirements and instructions for LCCBA Toolbox file handling

3.1 Computer system requirements and Excel settings

The LCCBA Toolbox ‚QuickCalc' and ‚Comparison' requires:

- a Windows-based computer with operation system Windows Version 7 or 10
- alternative: an Apple/Mac based computer with operation system OS-X or macOS
- free hard-disk space of at least 50MB
- a file manager such as ‚Explorer' or ‚Finder'
- a local installation of Office/Excel 2016 or Office/Excel 2019 on the computer. By experience, also previous versions of Office/Excel are compatible – please try latest version available on your computer.
- @Excel: Put calculation settings to "Automatic except for data tables" in order to speed up your computer.

3.2 Overview of file structure of the LCCBA Toolbox

The LCCBA Toolbox ‚QuickCalc' and ‚Comparison' is based on a set of four template Excel files:

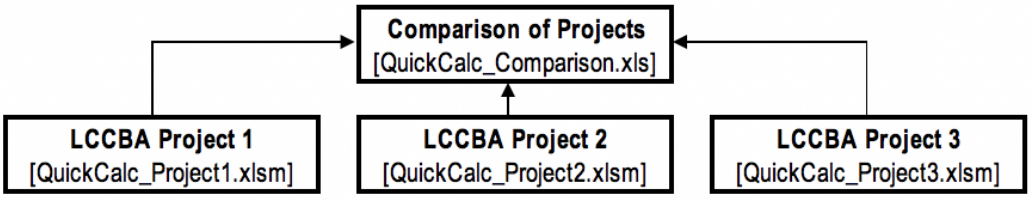

Figure 1: Overview of file structure of LCCBA Toolbox

- **Three identical project files** for up to three projects to be analysed, e.g. three investment alternatives in comparison to a base case. By way of example, the base case can be an existing ventilator in a steel works and up to three investment alternatives for ventilator speed control retrofits.
  These 3 template files are named [QuickCalc_Project1.xlsm], [QuickCalc_Project2.xlsm] and [QuickCalc_Project3.xlsm].
- One template file to compare the results of the three projects. This template file is named [QuickCalc_Comparison.xlsx].

- The three project files are linked to the file for comparison of results via the file names as shown in the figure below.

Kindly respect the instructions for handling of the LCCBA-toolbox files outlined in section 3.3.

By the way: All 'Quick.Calc' project files can also be used independently for an individual project LCCBA (without 'Comparison') and saved to any convenient location.

3.3 How to handle LCCBA-toolbox files

3.3.1 Save the original toolbox templates

Never work with or change the original toolbox folder. This ensures you have always the original toolbox as a template for future projects.

Always copy the original toolbox folder to a new project folder. Give the copied folder a new name however **never change any of the 4 file names in the toolbox**.

3.3.2 General framework for the file handling

These are the general rules for working with the four toolbox Excel files:

- For any comparison of projects, the three Project files as well as the 'Comparison' file **must be stored in the same folder**.
- **During copying or moving the files, all filenames must be kept unchanged.**

3.3.3 Opening the Toolbox

Opening the 'Comparison' file:

- The 'Comparison' file can be opened even if any of the 3 'QuickCalc'_Project files are not open.
- In this case, Excel asks when opening the ‚Comparison' file, whether the data from the linked but not opened project files should be [Updated] or [Not Updated].
- When the data is [Updated], Excel reads the current contents of the data from the unopened project files 'QuickCalc_Project 1, 2, 3' into the 'Comparison' file.
- If the data is [Not updated], Excel opens the 'Comparison' file with the project data that was valid when the 'Comparison' file was last saved.

- When opening the 'Comparison' file, however, there is no possibility for Excel to automatically open the project files 'Quickcalc'_Project 1, 2, 3' as well.

Opening the 'Quickcalc'_Project' files:

- Each project file can be opened individually, even if the other project files or the 'Comparison' file are not open.
- When a project file is opened, a password has to be entered. The password will be provided during the training.
- In the next dialogue box, Makros have to be activated.
- Next, the 'Exclusion of Liability and User Agreement' has to be confirmed with the [OK] button (otherwise the 'Quickcalc' does not open.
- You can start to enter or change existing input data.

Changes in the 'Comparison' file:

- To make and save any changes in the 'Comparison' file **the three project files have to be opened before making any changes in the 'Comparison' file**.
- If any changes in the 'Comparison' file are made and saved without having the three project files opened before, 'blind' links are created in the 'Comparison' file.
- These 'blind' links become valid when a copy of the 'Comparison' file and the three project files are saved to a new folder.
- When such a 'Comparison' file with blind links is opened, Excel reads the contents from the three project files from the actual (copied) project folder as well as from the three project files from (original) source project folder.
- For a correction of this situation
  - The 'Comparison' file of the actual project with the 'blind' links has the be deleted from the project folder.
  - A new 'Comparison' file has to be copied from the original Toolbox folder to the project folder of the actual project.

3.3.4 Copying/Moving of files

Usually copying/moving files this has to be done for:

- Operational LCCBA: copy the template files to a storage/folder.
- Back-ups and restoring processes: copy the actual file content to a storage/folder.

- Comparison with other projects: Copy/move files for a project to a working storage/folder or copy/move back Excel files for a project to the storage/folder.

Take-Away Chapter 3 How to handle LCCBA-toolbox files

- ✓ @Excel: Put **calculation settings** to "**Automatic except for data tables**"
- ✓ Please keep in mind: **Always copy the original toolbox folder** and save under a new project name, but **never change any of the 4 file names in the toolbox folder**.
- ✓ The **project files and the Comparison file must be stored in the same folder** to be compared.
- ✓ The **'Quick.Calc' project files can be used independently for an LCCBA**.
- ✓ The yellow cells also **function as a checklist**:
  - Have I considered this variable?
  - Is this variable relevant to my project?
  => When you conclude, the variable is not relevant for your project, insert 0 as input data.
- ✓ **Personal take-aways**:

4 General guidelines and hints ("tips and tricks") on the use of the Excel-based LCCBA calculation Toolbox

As mentioned in the introduction, a solid basic knowledge of Excel application and some experience to perform calculations in a given calculation sheet is needed as a prerequisite to use 'Quick.Calc'.

The following general guidelines, colour coding of cells as well as the more specific 'tips and tricks' on Excel-based calculation tools will help to use the LCCBA Toolbox.

4.1 General operating guidelines

Please also refer to details in section 3.

1. As a reminder: Always **copy original Toolbox folder to a new project folder** (in order to always have the original files of the Toolbox available).
2. To name projects: Choose a **meaningful file name** incl. date, version, sent to ..., e.g. PV40kW_YYMMDD_no-feed-in_to-Mark
3. **Put Excel calculation settings** to "Automatic except for data tables" to reduce calculation time of Excel
4. The Password to open the 'Quick.Calc' files will be provided during the training

4.2 Color coding for input data, results and comments; protected cells

1. Cells for entering required input data are marked in yellow.
2. Optional input data cells are marked in green.
3. All other cells are locked and cannot be changed (in order to avoid any unintended changes, malfunctions or misuse).
4. Calculated results are displayed in bold **red font**.
5. A few comments are provided in blue font (typically on the right side of the input cell).

4.3 Excel "tips and tricks"

1. **Use Excel as your calculator:** It is recommended to enter the formulas used for own calculations in the cells (use cells as your calculator instead of separate calculations) or in a comment. This will reduce mistakes and increases the traceability of the calculation (Typed calculations in cells **will serve as documentation** and will **help you to remember** how you achieved at certain input values).
2. **Use yellow cells as a check list:**
   - Have I thought about this variable?
   - Is this relevant to my project?
   => If not applicable to your project, put 0 as input data to document that you have considered it.
3. **Green colored Excel cells contain default input values**, often with linked formulas (e.g. financing dates are same as project dates):
   If you overwrite default values, automatic links are lost.
   (No worries: all other cells and formulas are protected).
   => **For new projects, copy from original tool file**
   => **If you want to keep a link**, you can multiply entire formula in green cell by 0 and add your input value.
   And as a reminder: Re-colour green cell to yellow
4. **Use green boxes on the side and below** the 'Quick.Calc' spreadsheet **for own calculations, notes, comments**. The 'Quick.Calc' and 'Comparison' files also contain empty sheets for own calculations or documentation purposes.

4.4 Plausibility check and quality assurance

1. The structure of 'Quick.Calc' requires data input in the top section of the sheet, followed by a display of the automatically calculated results (by way of graphs and tables). The consecutive composition of input and output areas facilitates the verification of the input data and the computed results.
2. *Important:* When entering data, the automatically produced **graphs are very helpful to check plausibility of input data.**
   => check graphs after each input section for plausibility!

4.5 Others/Taxes:

1. All data inputs and assessments have to be either performed with or without taxes (don't mix). It is recommended to perform calculations without taxes since they are raised based on the performance of the whole company and not just single projects.

Take-Away Chapter 4

- ✓ **Put Excel calculation settings** to "Automatic except for data tables"
- ✓ **Use Excel as your calculator** to reduce mistakes and increases the traceability of the calculation. Typed calculations in cells **will serve as documentation** and will **help you to remember** how you achieved at certain input values.
- ✓ When entering data, the automatically produced **graphs are very helpful to check plausibility of input data.**

  => check graphs after each input section for plausibility!
- ✓ **Personal take-aways**:

5 Operation manual 'Quick.Calc' and 'Comparison' using the example of an energy saving project

This section outlines a step by step operation manual for the ‚Quick.Calc', and ‚Comparison' Toolbox. In section 5.1 notes on preparation of input data are provided. Section 0 provides a step-by-step (or in the case of Excel cell-by-cell) guidance for the data input as per the order of sequence of the in the Excel sheets. Each data input section is displayed with a screenshot of the respective section. This is followed by a short explanation of the relevant input data by making reference to the respective cells in the Excel sheet. Sections h and 0 provide an overview of the results, which are automatically achieved from the ‚Quick.Calc' and ‚Comparison' calculations respectively.

5.1 Notes on preparation of input data

5.1.1 Overview of needed input data for an LCCBA

The following list provides an overview of the input data needed to perform a LCCBA. The list distinguishes between input parameters, which are needed for 1. All project types; for 2. Energy efficiency or savings projects only and for 3. Energy supply projects only.

1. ***All project types:***

- **Project schedule**: Start, duration, construction time in [YY; MM] *(cf. section 5.3.1)*.
- **Project-cycle cost of measures/investments** *(cf. section 5.3.3)*:
  CAPEX in [cost in selected currency], e.g. in [CNY],
  Variable and fix OPEX in [cost in selected currency/year], e.g. in [CNY/year].
- **Financing** *(cf. section 5.3.4):*
  Subsidies (if applicable) in [cost in selected currency], e.g. in [CNY],
  Debt financing share in [%],
  Debt nominal interest rate in [%/year] and any other cost of debt financing, in [% of total debt financing share],
  Expected return on equity in [%/year].

2. ***Energy Efficiency or Savings projects*** *(cf. section 5.3.2):*

- **Baseline data**:
  - Energy in [MWh/year] and **energy prices** in [cost in selected currency/MWh],
  optional: **Power demand** in [kW/year] and cost of power demand [cost in selected currency/(kW*year)],
  optional: **Maintenance cost** (or any other additional cost items in baseline) in [cost in selected currency/year], e.g. in [CNY/year],
  - Annual price increase factor in [%].

- **EE-measures** and related **savings**
  - Savings in [% of each baseline item] *(also savings denominations in other units, e.g. [MWh/year] are possible, however they have to be converted to [%] (cf. section 5.3.2)*.

3. **(Renewable) Energy supply projects:**

- **Heat** (e.g. hot water, steam or also compressed air possible) **sales**:
  - Energy in [MWh/year] and **energy prices** in [price in selected currency/MWh],
  - *optional:* **Power sales** in [kW/year] and price of power [price in selected currency/(kW*year)],
  - Annual price increase factor in [%].

- **Electricity sales**:
  - Electricity in [MWh/year] and **electricity prices** in [price in selected currency/MWh],
  optional: **Power sales** in [kW/year] and price of power [price in selected currency/(kW*year)],
  - *optional:* **Electricity feed-in in to grid** in [MWh/year] and **feed-in prices** in [price in selected currency/MWh],
  - Annual price increase factor in [%].

- **Technical performance data of supply equipment:**
  - Boiler: Heat output capacity of in [kW] and **annual efficiency** in [%];
  - CHP: Electric and heat output capacities in [$kW_{Electricity}$] and [kW_{Heat}], their respective **electric annual efficiency** in [%] and **heat annual efficiency** in [%]

and full load operating hours per year [hours/year];
- PV, hydro or wind: Electric peak load generation capacity in [kW_{peak}] and **annual electricity generation per peak load capacity** in [kWh/ kW_{peak}],
- Solar thermal: Installed collector area in [m^2] and **annual system yield per m^2 of collector area** in [kWh/(m^2 * year)][2],
- Internal electrical loads of all systems (total of losses) in [MWh/year].

- **Fuel purchasing cost:**
  - Cost of fuels (e.g. biomass, natural gas) in [cost in selected currency/MWh],
  - *optional:* **Cost of capacity charges** in [cost in selected currency/(kW*year)],
  - Annual price increase factor in [%].

5.1.2 Language, currencies and units in 'Quick.Calc' und 'Comparison'

The toolbox can currently be displayed in **5 different languages** (German, English, Chinese, French and Croatian[3]). For the selection of language, please refer to section 5.3.1.

Currently, there are **12 currencies available**[4], however the selection of currencies does not facilitate and automatic conversion functionality. For the selection of currencies, please refer to section 5.3.1.

All **physical units** are defined in metric units and cannot be changed. The units are always denoted next to the input cells and **must be strictly obeyed**.

5.1.3 Sources for input data

All input data for the LCCBA has to be provided from external sources such as energy bills, technical studies, offers from suppliers or previous projects. Typically, a project engineer (or the like) is tasked with data preparation. In many cases technical input data stem from energy audits, whereas economic and financial data are provided from energy accounting and financial departments.

Data sources will have to be prepared depending on the desired level of detail and

[2] Alternatively, data can also be entered as **heat peak load generation capacity** in [kW_{peak}] and **annual heat generation per peak load capacity** in [kWh/ kW_{peak}] (analogous to PV).

[3] Additional languages can be added upon request to office@Energetic-Solutions.eu

[4] Additional currencies can be added upon request to office@Energetic-Solutions.eu

accuracy of the LCCBA. In the case of a prefeasibility analysis, data inputs can be based on experiences from previous projects, manufacturing data, indicative price offers or cost estimations. In the case of an investment-grade LCCBA and for 'bankable' reports to management boards or FIs, data inputs must be backed by investment grade audits, project specific binding offers from suppliers or ready-to-sign supply contracts.

When contracting energy audits, it is recommended to clearly specify the requested results and levels of details in the ToR for the audit. The "Overview of needed input data for an LCCBA" in section 5.1.1 is recommend as a checklist in this regard.

5.2 Case study ventilator retrofit

The example project is about an energy saving measure (ventilator retrofit) of the Shagang company. In order to save energy, Shagang has improved the ventilator` speed regulator. After the replacement of the hydraulic frequency regulation by the frequency regulator with permanent magnet clutch, the power consumption was significantly reduced. In addition, hydraulic oil is no longer required, and noise and maintenance costs have also been reduced.

Inputdaten für Kalkulation	**Baseline** 现有状态	**Produkt A** **A** 公司方案	**Produkt B** **B** 公司方案
Projektlaufzeit [Jahre] 项目期限	**3 Jahre (3** 年**)**		
Bauzeit [Monate] 施工时间	**0**	**4 Monate (6** 月**)**	**2 Monate (3** 月**)**
Stromverbrauch pro Jahr [MWh/a] 年耗电量	**10.500**	**6.195**	**7.560**
Stromeinsparung pro Jahr [MWh/a] 年节电量	**0**	**4.305**	**2.940**
Sparquote des Stromverbrauches [%] 节电率	**0**	**41%**	**28%**
Strompreis [CNY /kWh] 平均电价	**0,65**	**0,65**	**0,65**
Betriebsstunden pro Jahr [h/a] 年运行时长	**4.200**	**4.200**	**4.200**
Leistung [kW] 功率	**2.500**	**1.475**	**1.800**
Wartungskosten [CNY/(kW·Jahr)] 维护费用	**180**	**70**	**120**
Hydraulikölkosten [CNY/Jahr] 液压油成本	**50.000**	**o. Hydrauliköl** 无需液压油	**o. Hydrauliköl** 无需液压油
Investition [CNY] 投资 **(Ausrüstungskosten** 设备费用**)**	**0**	**2.100.000**	**900.000**
Fremdkapitalanteil [%] 贷款比例		**65%**	
Darlehenszinsen [%] 贷款利率		**6.52%**	
Darlehenszeitraum [Jahre] 贷款期限		**2 Jahre (2** 年**)**	
Zinssatz Eigenkapital [%] 自有资金利率		**9%**	
Additional Benefits		**Noise ↓** **Product quality ↑**	

Figure 2: Case study: Table of input data

In the next sections 0 - 0 all text, which refers to this example is printed in green colour.

5.3 Data input ‚Quick.Calc'

This section provides a step by step guidance on the data entry. As a quick reminder: The color coding for input data, results and comments is a follows:

- Cells for entering required input data are marked in yellow.
- Optional input data cells are marked in green.
- All other cells are locked and cannot be changed (in order to avoid any unintended changes, malfunctions or misuse).
- Calculated results are displayed in bold **red font**.
- A few comments are provided in blue font (typically on the right side of the input cell).

5.3.1 Project name and term; selection of currency and language

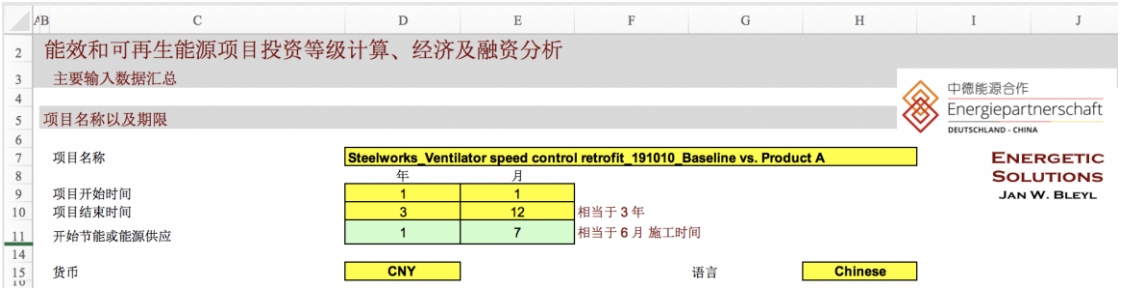

Figure 3: Data input section: Project name and term; selection of currency and language (screenshot)

a. Cell D7: Enter a **meaningful project name** (similar to file name, c.f. notes in section 4)

b. Cells D9:E10: Enter **project commencement and end dates** (beginning and end of accounting period). Total project term will automatically be calculated and displayed in cell F10. Recommended to use project years (e.g. 1 – 5), however also absolute years (e.g. 2020-2025) are possible.
Start dates always correspond to the first day of the month, end dates to the last day. E.g. for a project that runs from 01/2015 to 12/2017 the exact dates are 01/01/2015 to 12/31/2017.

c. Cells D11:E11: Enter **commencement of supply or savings cash flows** (typically after commissioning of project). Construction time will automatically be calculated and displayed in cell F11.

d. Cell D15: Pull down menu for **selection of currency** (a range of currently 12 currencies is available[4]). The selection of currencies does not facilitate and automatic conversion functionality.
e. Cell H15: Pull down menu for **selection of language** (currently German, English, Chinese, French and Croatian available[3]).

5.3.2 Savings project

***A short reminder on savings calculations formulae**:*

- ✓ *To calculate **Savings,** the following basic savings formula is always used:*
  ***Savings = Baseline cost – Actual cost** (post retrofit).*
  Savings in the 'LCCBA Toolbox' are calculated for a period of 1 year. It is important to use the same reporting period durations for both the Baseline and post retrofit consumptions.
- ✓ *To calculate **%-Savings**, the calculated savings are devided by the baseline (**%-Savings = Savings / Baseline**)*

Savings can be generated from any efficiency technology, which reduces final energy consumption, e.g. LED lighting, efficient electric motors, ventilators or compressed air systems, roof-top PV to name but a few.

	B	C	D	E	F	G	H	I	J
17	节能型项目数据输入								
19	基准线					节约量			
20									
21		用户（或领域）	Ventilator Baseline			措施		Product A: Variable speed drive	
22									
23		按计量表计读数得出的能源消耗量	10.500	MWh/年		节约量 按计量表计读数得出的能源消耗		41,0%	%
24		成本 按计量表计读数得出的能源消耗量 (平均值)	650,0	元/MWh				2.798.250	元/a
25									
26		容量/负荷成本	2.500,0	kW		节约量 容量/负荷成本		41,0%	%
27		成本 容量/负荷成本 (平均值)	0,0	元/kW/a				0	元/a
28									
29		其他成本： 例如 维护+修理	1,0	数量/年				79,4%	%
30			500.000	CNY /数量		节约量 其他成本： 例如 维护+修理		396.750	元/a
31		平均值 其他成本： 例如 维护+修理							
32		每年价格上升	0,0%	%		投资方的分享比例		100%	投资方
33									
34		基线值总量	7.325.000	元/a		节约总收益		3.195.000	元/a

Figure 4: Data input section: Baseline and Savings (screenshot)

Input data and results **Baseline section** (cells B19:E34):

a. Cell D21: Denomination of customer or area (for documentation purposes only).
b. Cell D23: **Energy consumption baseline** in [MWh]. Always convert to MWh if you have data in other units. Conversion should be documented in cell ("Use Excel as your calculator", cf. 4).

Basically, any type of energy carrier (e.g. electricity, fossil fuel but also water) and also energy unit can be used in LCCBA analysis, as long it is consistently used throughout the entire calculation.

c. Cell D24: Average **cost of energy** in [cost in selected currency/MWh].
d. Cell D26: **Peak power demand** in [kW], if applicable.
e. Cell D26: **Average cost of peak power demand** in [cost in selected currency/(kW_{peak}*year)], if applicable (depends on existing or possible future pricing structure of energy carrier).
   In example, cost of power demand is 0.
f. Cell D29: Option for **additional cost items in Baseline** (miscellaneous cost), e.g. maintenance cost. Enter [quantity or number of cost items/year], e.g. 12 monthly maintenance cycles.
   In example, there is 1 additional cost item per year.
g. Cell D30: **Cost of additional cost items in Baseline** in [Cost in selected currency/quantity or number of cost items], e.g. cost of monthly maintenance cycle.
   In example, this position consist of 2 items: 1. General maintenance cost (2.500 kW * 180 CNY/(kW*year) + 2. Cost of hydraulic oil (50.000 CNY/year) = 500.000 CNY/year.
   Note: Generally, maintenance cost can also be accounted for in section 5.3.3.
h. Cell D32: Denominate **average annual price increase factor** of baseline energy carrier in [%/a]. Price increase factors can also be negative.
i. Result cell D34: => **Total baseline sum** in [selected currency/year].

Input data and results **Savings section** (cells G19:J34):

a. Cell I21: Denomination of energy savings measures (for documentation purposes only).
b. Cell I23: Enter **%-savings of energy baseline** (cells D23*D24)
c. Result cell I24: => **Annual monetary savings from energy conservation** in [selected currency/year].
   Use results to check plausibility of calculations.
d. Cell I26: Enter **%-savings of power demand** (cells D26*D27)
e. Result cell I27: => **Annual monetary savings from power demand reductions** in [selected currency/year].

f. Cell I29: Enter **%-savings of additional cost items in Baseline** (miscellaneous cost) (cells D29*D30)
g. Result cell I30: => **Annual monetary savings from power demand reductions** in [selected currency/year].
h. Cell I32: The **savings share** (in [%]) **to the investor** can be adapted here, in case a share of the savings will go to another party, e.g. in an ESCo contract with a shared savings agreement. The **default value is 100%** (green cell).
i. Result cell I34: => **Total annual monetary savings from energy savings measures** in [selected currency/year].
   Comparison of cells I24, I27 and I30 allow to assess the relevance of each saving cash flow to the total in cell I34.

5.3.3 Project cycle cost: CAPEX, annual OPEX, other cost and revenues

	B	C	D	E	F	G	H	I	J
84	Project cycle cost项目周期成本 (所有项目)								
86	CAPEX					OPEX			
87									
88			CNY					元/a	
89		总成本	2.100.000				总成本	0	每年价格上升
90									
91		硬件1	2.100.000				管理费		
92		硬件2					维护+修理		0,0%
93		硬件3					保险		0,0%
94		规划					其他		0,0%
95		安装							
96		试运行							
97		咨询服务费							
98		其他成本：							
99									

Figure 5: Data input section: Project cycle cost: CAPEX, annual OPEX, other cost and revenues (screenshot)

Input data and results **CAPEX** (cells B86:D98):

a. Result cell D89: => **Total investment cost** in [selected currency].
b. Cells D91:D98: Enter **individual investment items** in [selected currency], e.g. hardware, planning, installation, commissioning, consulting services or miscellaneous cost in order to document the most important CAPEX positions. Denominations in cells C91:C98 can be overwritten.

Input data and results **OPEX** (cells G86:J98):

a. Result cell I89: => **Total operational expenditure** in [selected currency/year].
b. Cells I91:I94: Enter **individual operational expenditures** in [selected currency/year], e.g. management cost, maintenance & repair, insurance policies and

miscellaneous cost. Denominations in cells G91:G94 can be overwritten.
In our example, the maintenance cost are already accounted for in cell I29 (= 79,4%), by subtracting the remaining cost from the baseline maintenance cost (difference cost approach, cf. detailed calculation below).

Savings = Difference in maintenance cost (Formula: Savings = Baseline cost – Actual cost (post retrofit) =
Maintenance cost in Baseline (180 CNY/(kW*year) * 2.500 kW + 50.000 = 500.000 CNY/year)
– Actual maintenance cost (post retrofit) (70 CNY/(kW*year) * 1.450 kW = 103.250 CNY/year)
= Net savings in maintenance cost (396.750 CNY/year)

c. Cell J91: Denominate **average annual price increase factor of OPEX** in [%/a]. Price increase factors can also be negative.

Input data **Other cost and benefits during project term** (cells B101:J118):

a. Cells E104:I104: Enter **any other cost or revenues for any particular year during the project-cycle** in [selected currency/year], e.g. a special maintenance budget for an exchange of certain parts of the saving measure in year 3 or a replacement of an inverter in year number 10 of a PV system (recapitalization of assets).
Note: **All cost have to be entered as negative numbers.**
Other revenues could stem e.g. from sales of CO_2-certificates or a residual value of the equipment or its projected sale at the end of the project term.
In case of longer project terms, cells for additional years will be displayed automatically, according to number of years of project term.

5.3.4 Financing: Subsidies, Debt and Equity

	B	C	D	E	F	G	H	I	J	K
121	融资: 外债及自有资金, 补助+工程补贴									
123			项目年	1	2	3				
124	补助+工程补贴		CNY	0						
125				0,0%						
126										
127	负债 (1/2)			融资占比	年利率	贴现点	有效利率	年归还本金次数		
128		贷款一	1.365.000	65,0%	6,52%	0,00%	6,52%	1		
129		贷款二	0	0,0%	0,0%	0,00%	0,00%	4		
130		贷款三	0	0,0%	0,0%	0,00%	0,00%	4		
131		贷款四	0	0,0%	0,0%	0,00%	0,00%	4		
132		等额本息贷款	0	0,0%	0,0%	0,00%	0,00%	4		
133										
134	贷款总计		1.365.000	65,0%						
136	自有资金		735.000	35,0%	9,0%	自有资金的收益率主要用于计算混合利率，该混合利率用于计算净现值时的折现率				
138	自有资金和外部资金的混合利率				7,40%	贴现利率				
139										
140				贷款起始时间		首次清偿		最后一期清偿		
141	负债 (2/2)			年	月	年	月	年	月	
142		贷款一		1	1	1	12	2	12	
143		贷款二		1	1	1	3	3	12	
144		贷款三		1	1	1	3	3	12	
145		贷款四		1	1	1	3	3	12	
146		等额本息贷款		1	1	1	3	3	12	

Figure 6: Financing: Subsidies, Debt and Equity (screenshot)

a. Cell E124:G124: **Subsidies** in project years 1- 3 in [selected currency].
b. Result cell E125: **Subsidy financing share of total investment** in [%].
c. Rows 128 and 142: Loan 1, with following input parameters and results:
   - Cell E128: **Loan share of total investment** in [%] (sum of investment, planning and commissioning …)
   - Cell F128: **Annual nominal interest rate** in [%]
   - Cell G128: **Banking fee** (disagio) in percentage of loan => this share is not paid out, e.g. if the disagio is 1% of a loan of 100,000 CNY, hence, the bank only disburses 99,000 CNY and 1,000 CNY are kept as a banking fee.
   - Cell I128: **Number of principal and interest payments** per year on a range from 1-12.
   - Result cell H128: **Effective interest rate** in [%] (f(number of principal payments and bankfing fee).
   - Result cell D128: **Loan amount** in [selected currency].
   - Cells E142:F142: **Date of borrowing** (default value is project commencement).
   - Cells G142:H142: **Date of first principal payment** (default value is project commencement) => option for grace period.
   - Cells I142:J142: **Date of last principal payment** (default value is project end) => option for shorter loan term.

If you change the default value, remember to re-colour the respective cell to yellow.

d. Rows 129:132 and 142:146: Optional **further loans** similar to loan 1. The first 4 loans have fixed repayments and declining interest shares. Loan 5 (annuity loan) has nominally fixed-rate mortgages, so shares of interest and principal payments vary over the loan term.
e. Result cell D134: Total loan amount in [selected currency]
f. Cell F136: **Expected rate of return on equity capital** in [%]
g. Result cell D136:E136: **Equity amount** in [selected currency] and **equity share** in [%].
h. Result cell F138: **Weighted Average Cost of Capital** (WACC) in [%] => used for discounting of project cash flow => cf. cell E202

This concludes the data input sections of Quick.Calc. In the following sections of the manual, the results of the LCCBA analysis is described.

5.4 Results ‚Quick.Calc' tool

5.4.1 Introduction to results section

The following results of the 'Quick.Calc' LCCBA are automatically generated and displayed in 4 different representations:

1. Net cash flows graph (5.4.2),

2. Summary table of results and KPIs (5.4.3),

3. Financing graph (5.4.4) and

4. Table of individual cash flows (5.4.5).

In case of longer project terms, additional years will be displayed automatically in the CF graph and table, according to number of years of project term.

When analyzing and interpreting LCCBA results, the method of approach, definitions, the variety of applications but also its limitations as outlined in the introduction in section 1, should be kept in mind.

By long-term experience, copies of some or all 4 LCCBA representations provide an excellent basis for concise management reports to decision makers.

5.4.2 Investment, subsidies, net cash flows and profit graph

The first representation of results displays the total investments, subsidies, net project, net equity, net debt CFs and the profit (annual, cumulative) as a function of the project term. The annual net CFs are displayed in bars, the cumulative CFs as lines. The project CF is displayed in grey, the equity CF in dark blue, the debt CF in light blue and the annual profit in green bars and lines.

The textbox on the top left of the graph summarizes the economic KPIs of the P-CF and E-CF.

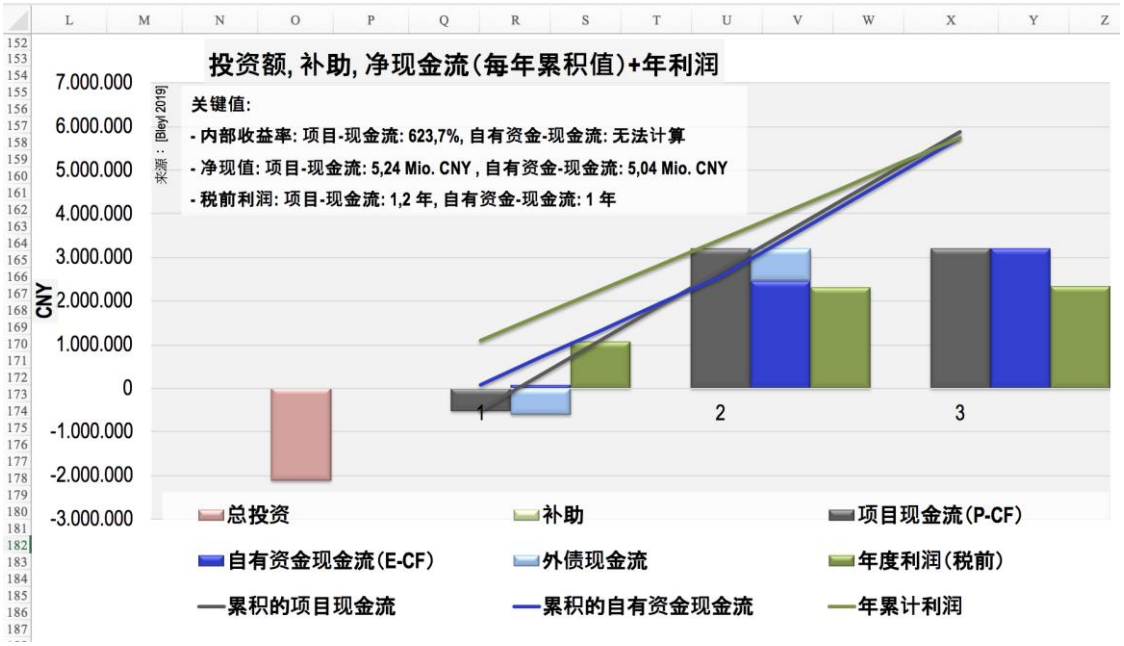

Figure 7: Investment, subsidies, net cash flows and profit (annual, cumulative) figure (screenshot)

The first negative column represents the initial expenditure for the total investment (CAPEX) (2,1 Mio CNY). In case of subsidies, these would be displayed as a positive CF on top of the CAPEX bar, however in this example there are no subsidies (0 Mio CNY).

To the right, the net annual and cumulative cash flows and profits over the project duration of three years are displayed. The positive cumulative P-CF shows, that the project generates a net surplus. Its discounted NPV comes out positive (NPV = 5,24 Mio CNY) with a very high IRR (IRR = 624%).

Likewise, the cumulative E-CF shows, that the equity investment generates a net surplus for the equity investor (NPV: 5,04 Mio CNY; the IRR cannot be calculated in this example, due to lack of any negative CF).

So, the essential message is: In three years, the investor has a substantial surplus after having paid all expenses including debt service (principal payments and interest). The cumulative pre-tax profit shows the same result.

5.4.3 Summary table of results and KPIs

The second representation of results displays the key results and KPIs of the LCCBA, separated for project and equity cash flows and in the format of a table.

	AB	C	D	E	F	G	H
193	经济性预测的总结和特征值						
194							
195				项目现金流		自有资金现金流	
196		项目期限	年	3			
197		总投资	CNY	2.100.000			
198		自有资金	CNY	-		735.000	
199		借款	CNY	-		1.365.000	
200		累积的自有资金现金流	CNY	5.887.500		5.754.003	
201		贴现利率	%	7,4% （混合利率=加权平均资本成本WACC）		9% （自有资金利息）	
202		净现值	CNY	5.242.249		5.044.391	
203		内部收益率（IRR）	%	623,7%		无法计算	
204		动态投资回收期	年	1,2		1,0	
205		负贷偿债能力比率	-	-		5,4	
206							
207				总计（整个项目期内）		年平均值	
208		累积的项目现金流	CNY	5.887.500		1.962.500	
209		累积的自有资金现金流	CNY	5.754.003		1.918.001	
210		总投资	CNY	2.100.000		-	
211		收入	CNY	7.987.500		2.662.500	
212		费用	CNY	2.233.497		744.499	
213		利润（企业经营的常规数据）（利用会计学计算公式得出的企业税前利润）	CNY	5.754.003		1.918.001	

Figure 8: Summary table of key results and KPIs for project and equity cash flows (screenshot)

Basically, the results shown are the same as in section 5.4.2 in the format of table. In addition to the previous CF graph, the table also summarizes the project duration, equity and debt financing volumes, interest rates for discounting, cumulative P-CF and E-CF values, revenues, expenditures and profits (before taxes).

5.4.4 Debt Services, Cash Flow Available for Debt Service (CFADS) and Debt Service Cover Ratio (DSCR)

The third representation of results focusses on the perspective of the debt provider or financial institute (FI). The FI will in many cases be a bank (of different sorts), but could also be a crowdfunding provider or any other form of borrowed capital.

The figure displays the debt services obligations (from principal and interest payments), the Cash Flow Available for Debt Service (after all other obligations have been deducted). On the right Y-axis, the Debt Service Cover Ratio (DSCR) is displayed. In addition, the textbox provides a summary of the key figures and KPIs.

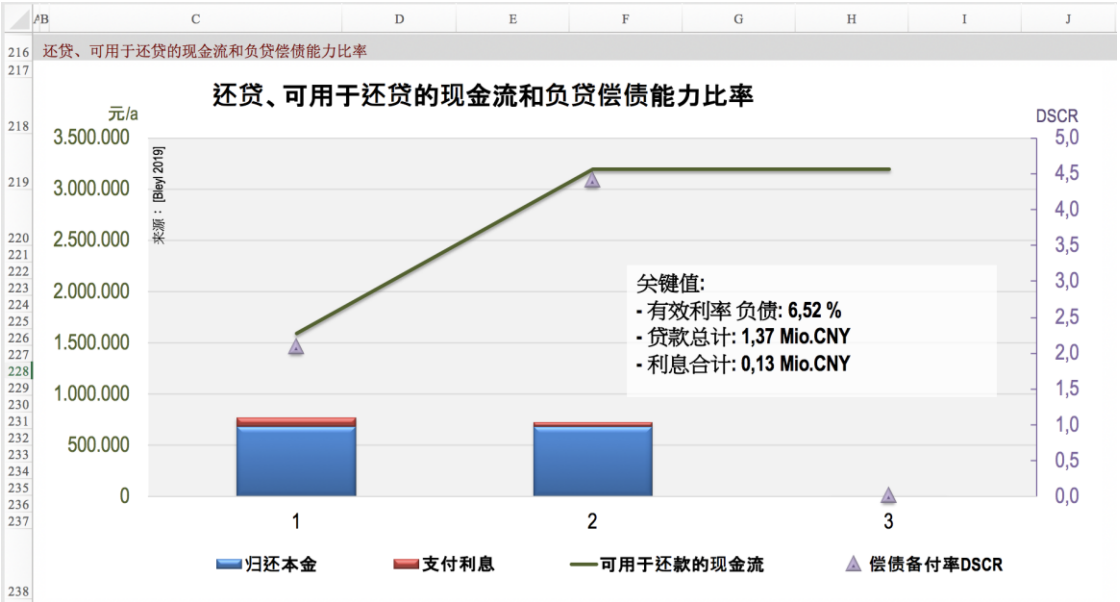

Figure 9: Investment, subsidies, net cash flows (annual, cumulative) figure (screenshot)

5.4.5 Net cash flow and liquidity table

The last representation of results is a table, which contains the key cash flows of the project on an annual basis as well as also their cumulated totals and mean annual averages. The first rows of the table refer to financing (investment and debt service), followed by revenues (from savings and sales of energy) and OPEX cash flows. As resulting bottom lines, both project and equity cash flows are displayed. The last two rows show the CFADS and DSCR.

	AB	C	D	E	F	G	H	I	J
240	现金流和流动性预测								
241									
242				单位	累积的	算术平均值	1	2	3
243	投资额								
244		自有资金		CNY	735.000	-	735.000	0	0
245		投资成本		CNY	2.100.000	-	2.100.000	0	0
246		补助和工程补贴		CNY	0	-	0	0	0
247		贷款放款		CNY	1.365.000	-	1.365.000	0	0
248									
249	利息+归还本金（负债）			**CNY**	**1.498.497**	**499.499**	**771.498**	**726.999**	**0**
250		贷款清偿额		CNY	1.365.000	455.000	682.500	682.500	0
251		负债的利息		CNY	133.497	44.499	88.998	44.499	0
252									
253	运营期间的收入总额			**CNY**	**7.987.500**	**2.662.500**	**1.597.500**	**3.195.000**	**3.195.000**
254		节能措施		CNY	7.987.500	2.662.500	1.597.500	3.195.000	3.195.000
255		出售能源		CNY	0	0	0	0	0
257	运营期间的成本总额			**CNY**	**0**	**0**	**0**	**0**	**0**
258		外购能源		CNY	0	0	0	0	0
259		本公司内部人工成本		CNY	0	0	0	0	0
260		其他运营费用（外部的）		CNY	0	0	0	0	0
261		其他成本：		CNY	0	0	0	0	0
262	项目现金流（P-CF）			**CNY**	**5.887.500**	**1.962.500**	**-502.500**	**3.195.000**	**3.195.000**
263	自有资金现金流（E-CF）			**CNY**	**5.754.003**	**1.918.001**	**91.002**	**2.468.001**	**3.195.000**
264	可用于还款的现金流			CNY	7.987.500	2.662.500	1.597.500	3.195.000	3.195.000
265									
266	偿债备付率DSCR			**-**	**-**	**-**	**2,1**	**4,4**	**0,0**

Figure 10: Investment, subsidies, net cash flows (annual, cumulative) figure (screenshot)

5.5 Results ‚Comparison' tool

The ‚Comparison' tool automatically summarizes the results of up to three ‚Quick.Calc' LCCBAs in a table and graphical format in order to facilitate and comparison decision making for the most suitable project option.

By way of example the following sections represent the results of the three options of the ventilator case study outlined in section 5.2.

5.5.1 'Comparison' table

The following table provides a summary of the key input parameters, results and economic and financial KPIs of up to three project variations.

经济性预测的总结和特征值

		项目 1		项目 2		项目 3	
		项目现金流	自有资金现金流	项目现金流	自有资金现金流	项目现金流	自有资金现金流
项目期限	年	3		3		3	
总投资	CNY	2.100.000		900.000		2.520.000	
自有资金	CNY	-	735.000	-	315.000	-	882.000
借款	CNY	-	1.365.000	-	585.000	-	1.638.000
累积的自有资金现金流	CNY	5.887.500	5.787.377	4.587.500	4.544.590	5.467.500	5.347.353
贴现利率	%	7,5% (混合利率=加权平均资本成本WACC)	9% (自有资金利息)	7,5% (混合利率=加权平均资本成本WACC)	9% (自有资金利息)	7,5% (混合利率=加权平均资本成本WACC)	9% (自有资金利息)
净现值	CNY	5.234.331	5.076.387	4.138.766	4.040.975	4.814.331	4.648.092
内部收益率（IRR）	%	623,7%	无法计算	无法计算	无法计算	327,4%	1255,1%
动态投资回收期	年	1,2	1,0	1,0	1,0	1,3	1,1
负贷偿债能力比率	-	-	5,4	-	8,6	-	4,5
		总计（整个项目期内）	年平均值	总计（整个项目期内）	年平均值	总计（整个项目期内）	年平均值
累积的项目现金流	CNY	5.887.500	1.962.500	4.587.500	1.529.167	5.467.500	1.822.500
累积的自有资金现金流	CNY	5.787.377	1.929.126	4.544.590	1.514.863	5.347.353	1.782.451
总投资	CNY	2.100.000	-	900.000	-	2.520.000	-
收入	CNY	7.987.500	2.662.500	5.487.500	1.829.167	7.987.500	2.662.500
费用	CNY	2.200.123	733.374	942.910	314.303	2.640.147	880.049
利润（企业经营的常规数据）（利用会计学计算公式得出的企业税前利润）	CNY	5.787.377	1.929.126	4.544.590	1.514.863	5.347.353	1.782.451

Figure 11: Comparison table of key results and KPIs (screenshot)

Firstly, key input parameters like project duration, investment volume, invested equity and debt volumes are summarized. Secondly, the table compares key economic results and KPIs of the LCCBAs of both project and equity CFs, such as cumulative CF, NPVs, IRRs and payback periods. Thirdly, the Loan Life Coverage Ratio is an indicator for the liquidity over the project life-cycle.

The second section of the Comparison table provides a summary of economic results over the entire project cycle as well as annual averages of the Cumulative project CF, Cumulative equity CF, revenues, expenditures and earnings.

5.5.2 'Comparison' figure

The 'Comparison' figure displays the Cumulative project CF of up to 3 project alternatives.

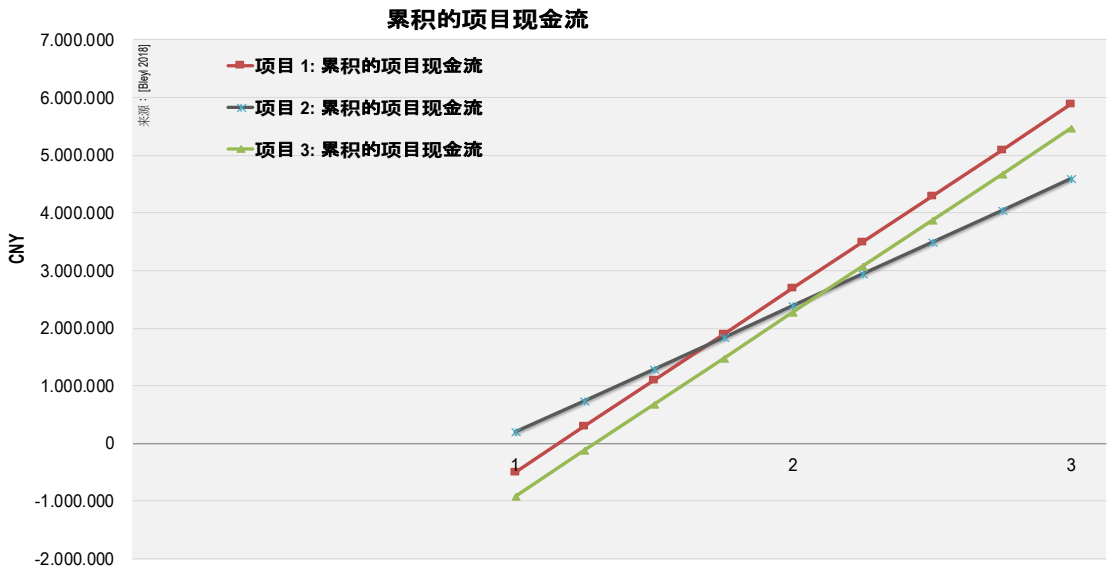

Figure 12: Comparison graph of cumulative project CFs (screenshot)

All three project variants generate a surplus between 4,9 and 6,0 Mio CNY over the project period of 3 years. Likewise, all economic KPIs (IRR, NPV and PBT) and also the financial KPI (LCCR) are indicating a highly favorable performance, as can be read from the 'Comparison' table. This means, any of the three investment options could be implemented (even option 3 with 20% higher CAPEX), however the most favorable is option 1, provided the higher upfront CAPEX can be financed. Project 2 generates a positive project CF already in year 1.

Take-Away Chapter 5

***A short reminder on savings calculations formulae**:*

- *To calculate **Savings,** the following basic savings formula is always used:*
  ***Savings = Baseline cost – Actual cost** (post retrofit).*
- *To calculate **%-Savings**, the calculated savings are devided by the baseline (**%-Savings = Savings / Baseline**)*

✓ ***Energy consumption baseline** in [MWh]. Always convert to MWh if you have data in other units. Conversion should be documented in cell ("Use Excel as your calculator"*

✓ *Copies of some or all **4 Quick.Calc representations** as well as the **2 Comparison figures provide an excellent basis for concise management reports to decision makers**.*

✓ ***Personal take-aways**:*

This concludes the instruction manual of the LCCBA Toolbox 'Quick.Calc' and 'Comparison' for Chinese Experts and Companies. The authors wish to thank you for your careful attention through to the very end of it.

By way of a quick summary, you have been introduced to the key concepts and basics of LCCBAs. The training and this manual should enable you to actually perform LCCBAs for your own projects. This will enable you to prepare well-grounded recommendations for investment decisions to decision makers and other stakeholders. As a result, you can help your company to save substantial amounts of money over the project life-cycle and also generate other 'Multiple Benefits' of investments into Energy Efficiency and Renewable Energies. And last but not least, help to relieve the heavy burden on the environment.

Once more, we wish you the best of luck with your LCCBA calculations and even more so for the implementation of your investment projects! In case of questions or remarks, please feel free to contact office@Energetic-Solutions.eu or maximilian.rys-sel@giz.de.

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6 Abbreviations and Glossary

This section provides a summary of abbreviations and acronyms used in the manual and also provides definitions of key concepts in the Glossary.

6.1 Summary of abbreviations and acronyms

AC	Air conditioning
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development) (www.BMZ.de)
CAPEX	Capital expenditure
CF	Cash flow
CFADS	Cash flow available for debt service
CFL	Compact fluorescent Lamp
CfP	Calls for proposals
CHP	Combined Heat and Power
CMVP	Certified Measurement and Verification Professional
D-CF	Debt cash flows
DPB	Dynamic payback period
DPR	Detailed Project Report
DSM	Demand Side Management
DSCR	Debt-Service Coverage Ratio
E-CF	Equity cash flows
ECM	Energy Conservation Measures
EE	Energy efficiency
EPC	Engineering Procurement Construction
EPC	Energy Performance Contracting, also labelled as Energy Savings Performance Contract (ESPC) (performance-based supply of energy savings)
ES	Energy service

ESC	Energy Supply Contracting (performance-based supply of useful energy)
ESP	Energy Service Provider
ESCo	Energy Service Company
ESPC	Energy Services Performance Contract, c.f. EPC
EUR	Euro (€) - European currency unit
FA	Financial assistance
FI	Finance institution
GHG	Greenhouse gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (www.giz.de)
HVAC	Heating, Ventilation, Air-Conditioning
IEA	International Energy Agency
IEA DSM	International Energy Agency Demand Side Management Implementing Agreement (www.ieadsm.org)
IEC	Integrated Energy Contracting
IPMVP	International Performance for Measuring and Verification Protocol
IRR	Internal Rate of Return
KfW	Kreditanstalt für Wiederaufbau Entwicklungsbank (German Development Bank) (www.kfw.de)
KPI	Key performance indicator
LCC	Life-cycle cost
LCCA	Life-cycle cost assessment
LCCBA	Life-cycle cost-benefit analyses
LLCR	Loan life cover ratio
M&V	Measurement and Verification
MoU	Memorandum of Understanding
NEB	Non-energy-benefits
NPV	Net Present Value

OEM	Original equipment manufacturer
O&m	Operation and maintenance
OPEX	Operational expenditure
PB	Payback period
P-CF	Project cash flows
PLC	Project life-cycle
RE	Renewable Energy
RFP	Request for proposals
SWH	Solar Water Heating
TA	Technical assistance
Task 16	Task 16 is the long-term ESCo task of the IEA DSM (www.ieadsm.org => Task 16)
ToR	Terms of Reference
WACC	Weighted Average Cost of Capital

6.2 Glossary and definitions of key concepts

The source of the following definitions is Investopedia.com.

Capital expenditures (CapEx) are funds used by a company to acquire, upgrade, and maintain physical assets such as property, buildings, an industrial plant, technology, or equipment. CapEx is often used to undertake new projects or investments by the firm. In other words, CapEx is any type of expense that a company capitalizes, or shows on its balance sheet as an investment, rather than on its income statement as an expenditure [Source: https://www.investopedia.com/terms/c/capitalexpenditure.asp].

Cash flow available for debt service (CFADS) is a ratio that measures the amount of cash a company has on hand relative to its debt service obligations due within one year. Debt service obligations include all current interest payments and current principal repayments. Sometimes lease obligations are part of the denominator [Source: https://www.investopedia.com/terms/c/cads.asp].

Debt-Service Coverage Ratio (DSCR) is a measurement of the cash flow available to pay current debt obligations in corporate finance. The ratio states net operating income as a multiple of debt obligations due within one year, including interest, principal, sinking-fund and lease payments. The ratio reflects the ability to service debt given a particular level of income [Source: https://www.investopedia.com/terms/d/dscr.asp].

Internal Rate of Return (IRR): The IRR is a metric used in capital budgeting to estimate the profitability of potential investments. The internal rate of return is a discount rate that makes the NPV of all cash flows from a particular project equal to zero. IRR calculations rely on the same formula as NPV does [Source: https://www.investopedia.com/terms/i/irr.asp].

Key performance indicators (KPIs) refer to a set of quantifiable measurements used to gauge a company's overall long-term performance. KPIs specifically help determine a company's strategic, financial, and operational achievements, especially compared to those of other businesses within the same sector [Source: https://www.investopedia.com/terms/k/kpi.asp].

Loan Life Coverage Ratio (LLCR) is a financial ratio used to estimate the solvency of a firm, or the ability of a borrowing company to repay an outstanding loan. LLCR is calculated by dividing the net present value (NPV) of the money available for debt re-

payment by the amount of outstanding debt. LLCR is similar to the debt service coverage ratio (DSCR), but it is more commonly used in project financing because of its long-term nature. The DSCR captures a single point in time, whereas the LLCR addresses the entire span of the loan [Source: https://www.investopedia.com/terms/l/llcr.asp].

Operating expense (OPEX) is an expense a business incurs through its normal business operations and can be distinguished in **variable OPEX** such as fuel and electricity cost and **fix OPEX** such as technical operation and maintenance, insurance, personal, chimney sweep or M&V.

Net Present Value (NPV): NPV is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project [Source: https://www.investopedia.com/terms/n/npv.asp].

Payback period (PB) refers to the amount of time it takes to recover the cost of an investment. Simply put, the payback period is the length of time an investment reaches a breakeven point [Source: https://www.investopedia.com/terms/p/payback-period.asp].

Weighted Average Cost of Capital (WACC) is a calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds, and any other long-term debt, are included in a WACC calculation [Source: https://www.investopedia.com/terms/w/wacc.asp].

Please also refer to the Introduction in section 1 for a conceptual classification of the key concepts into the LCCBA context.

Further explanations and background information can be accessed through these links: http://www.investopedia.com/terms/a/ and https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca.

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7 Space for Participants Notes