in co-operation with: ieadsm energy efficiency 16 Task 16 "Energy Services" www.ieadsm.org

giz

ENERGETIC SOLUTIONS
JAN W. BLEYL

Investment-grade Calculation, Analysis & Financing of Energy Projects
(Focus on Energy Performance Contracting)

Introduction & Hands-on Training

Jan W. Bleyl, Energetic Solutions & IEA DSM Task 16
Simon Zellner, GIZ
Bangkok, Thailand, January 2016

Training goals

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1. Introduction to **Project** / **Life Cycle Cost concept** and to basics of **dynamic economics calculation**
2. Familiarize you with **economic**, **financial** & **banking language**
3. Detailed introduction to a **comprehensive investment-grade calculation tool** for EE and RES projects
4. Enable you to **calculate** your own **savings projects**
5. Discuss **results, KPIs, risks, sensitivity analyses, reporting**

⇒ **"Awareness through Cash Flows"**

⇒ **Facilitate cooperation with financial institutions, technical due dilligence and project management**

⇒ **Support EE, RES & ESCo market development**

Calculation Training_Thailand
Agenda day 1_Tuesday 19 Jan. '16

When	*Topic*	*Who*
09:00	Introduction to TGP-EEDP and the training	Dr. Beerepoot
09:10	Training goals and agenda Introduction of life cycle cost concept	Bleyl
09.40	Personal introductions of participants. Your wishes and expectations for the training?	Participants
10:00	*Break*	
10:15	Basics of dynamic economics calculation for ESCo/EE/RES projects	Bleyl
11:30	*1. Group work:* Cost components + data sources of your projects?	Participants
12:00	*Lunch*	
13:00	Calculation Tool: Liability exclusion and NDA Intro to calculation tool + manual => *focus RES, savings model (EE)* Joint calculation of EE project example *(re-lighting, PV or other?)*	Bleyl Bleyl Zellner
14:30	*Break*	
14:45	*2. Group work:* Own Calculation + presentation & discussion of example incl. financing ... Q&A	Participants + Zellner & Bleyl
16:00	*End of day 1 (agenda adjustments possible, subject to training needs)*	

Calculation Training_Thailand
Agenda day 2_Wednesday 20 Jan. '16

When	*Topic*	*Who*
09:00	Summary of calculation tool and Q&A from previous day *3. Group work:* Calculation of own EE projects *(or other examples)*	Bleyl Participants
10:30	*Break*	
10:45	*3. Group work (cont'd)* => Presentation & discussion of results, incl. KPIs, CFADS, financial engineering, parameter sensitivity ... Q/A	Participants + Zellner & Bleyl
12:00	*Lunch*	
13:00	Manual and automatic sensitivity analyses with calc.-tool	Bleyl
13:45	„Quickcalc": Intro and PV example	Bleyl *or* Zellner
14:30	*Break*	
14:45	Deepening of selected training topics based on participants project calculation examples	Participants + Bleyl + Zellner
16:00	*End of day 2 (agenda adjustments possible, subject to training needs)*	

Calculation Training_Thailand

Agenda day 3_Thursday 21 Jan. '16

When	Topic	Who
09:00	Summary and Q&A from previous day *4. Group work:* Project risks: Identification and mitigation	Bleyl Participants
10:30	*Break*	
10:45	ESCo calculation tool as management instrument for projects: Reporting, risk- + sensitivity analyses, price development ...	Bleyl Participants
11:30	Wrap up: Q/A, your next steps towards investment projects? Feed back on the training	Bleyl + Zellner + Participants
12:00	*Lunch*	
13:00	Financing of ESCo/EE/RES projects from a bank's perspective: Strategy, procedures, approval criteria … Q & A	Mr.Ittiporn Intravisit Kasikorn Bank
13.30	ESCO Fund: Strategy, procedures and approval criteria	Mr.Anant, ECFT
14:00	Revolving Fund: Strategy, procedures and approval criteria	Mr.Chetapong, DEDE
14.30	*Break*	
14:45	Certificate ceremony and final remark	Dr. Beerepoot
15:30	*End of training (agenda adjustments possible, subject to training needs)*	

Target group & required background knowledge required for the training

Target group:

1. **Employee of ESCos and/or Utilities**
2. **Project developers and Facilitators of energy service projects**
3. **Employees of financial institutes**
4. **Employees of research center (energy sector)**
5. **Public sector**

Required knowledge:

1. **Basics on energy savings, energy services & ESCo business models**
2. **Technical and/or economical education with regards to the energy business**
3. **Solid basics on Microsoft Excel application**

Bring your projects, laptops & questions
Requested min. data inputs (or assumptions)

All project types:

- **Project story outline**
- **Project/contract term**
- **Life cycle cost of measures**: Investment (CAPEX) and operation&maintenance, insurance, management, controlling ... (OPEX)
- **Financing:** Interest rates; equity & debt shares; subsidies

Energy efficiency / Savings / EPC projects:

- **Baselinedata**: energy & prices (in MWh & price/MWh, maintenance cost ...)
- **EE-measures** and related **savings** (in MWh or in % of baseline)

Renewable / Supply / ESC projects:

- **Heat + Electricity sales**: energy & prices (in MWh & price/MWh ...)
- **Technical performance data** of equipment like boiler, CHP, PV, solar therm (kW, operating hours, annual efficiencies ...)
- **Energy prices**: Electricity, fuels (in Price/MWh, price/kW ...)

GIZ ESCo Guide: Assessing Framework Conditions for ESCos

A good introduction to ESCo business models, framework conditions …

Life / Project Cycle Cost (LCC / PLC) = Total Cost of Ownership (TCO)

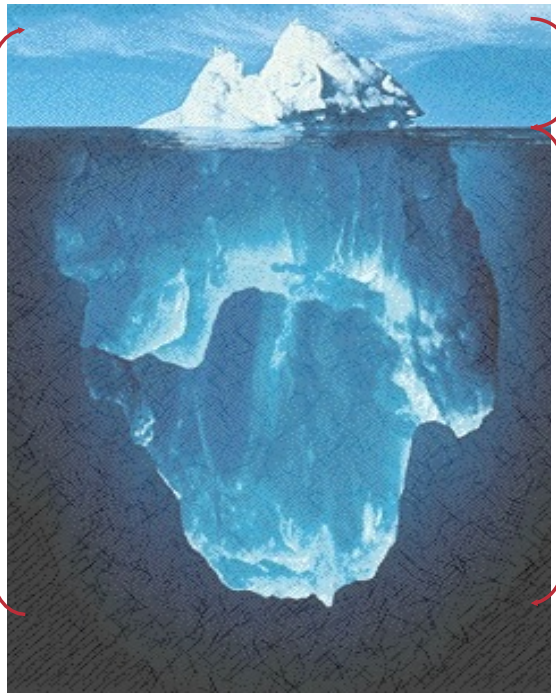
The economic rationale for Energy Efficiency (EE) **and Renewables** (RES)

Investment vs. Total Cost Risks?

Investment vs. Total Cost
=> *EE & RES require Life Cycle Cost approach!*

=> *Solution:*

Total Cost (= Project-/ Life Cycle Cost (LCC)) **calculation to compare investment options**



Up-front **Investment** cost *(=> **CAPEX**)*

Operation cost over **project-/ life cycle** *(=> **OPEX**)*

Life Cycle Cost appraisal needed

Economical **investment decisions** must be calculated according to **project** (or better) **life cycle cost**:

- The iceberg phenomenon:
  Invest = visible part, o&m = invisible/underwater but def. there
- Invest. (Capex) and operating (Opex) budgets not coordinated
- Know how and tools often missing
- National + local policies and regulations often not in place

⇒ **Procurement rules allow for LCC evaluations of offers**

⇒ **ESCo models are LCC optimized => substantial advantage!**

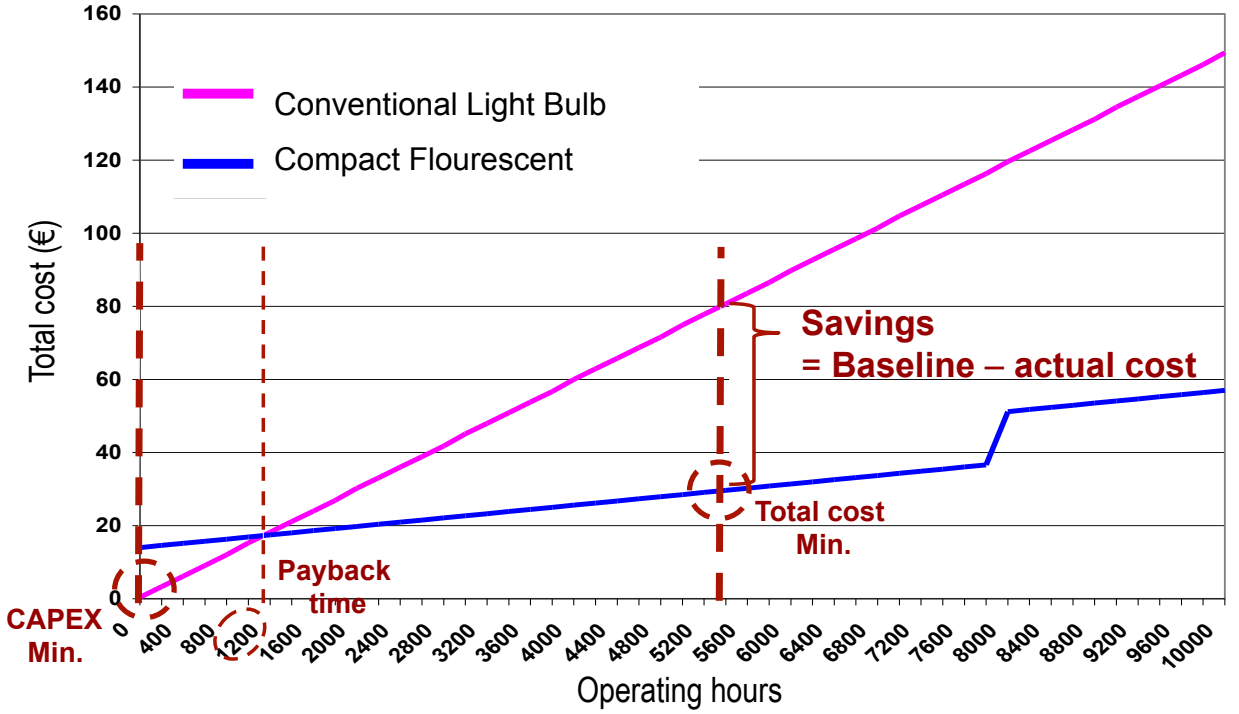
Three categories of cost
(accord. to VDI 2067, Ö-Norm 7140 …)

1. **Capital cost** - e.g. annuities => ***CAPEX***
   - Investment minus subsidies
   - Financing cost (interest rate, fees …)
   - Annuities: Duration of use + interest rate
2. **Consumption related cost** - e.g. gas and electricity => ***variable OPEX***
   - energy cost or energy savings on a yearly bases
   - Important: take development of energy prices into account
3. **Operation & maintenance cost** - e.g. burner service, insurance, manhours, chimney sweep => ***fix OPEX***
   - all expenditures for operation & maintenance incl. replacement and staff

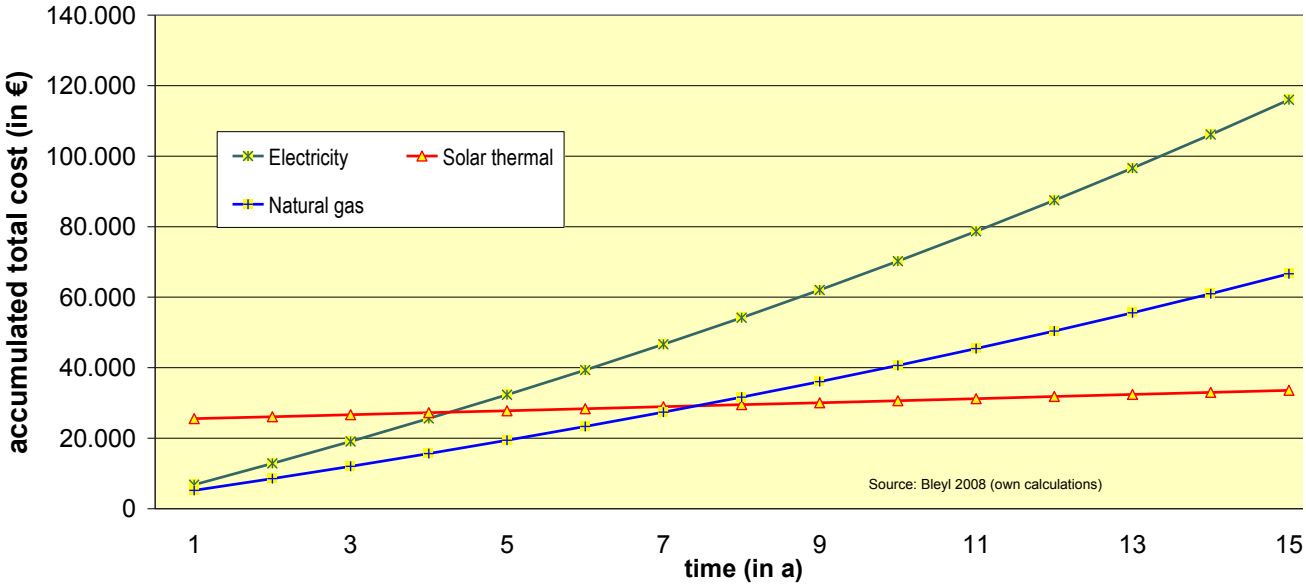
=> ∑ (Sum of all cost categories) **= Total-, Life-** or **Project cycle cost** (LCC)

=> **Investment decisions and cost comparison always based on LCC!**

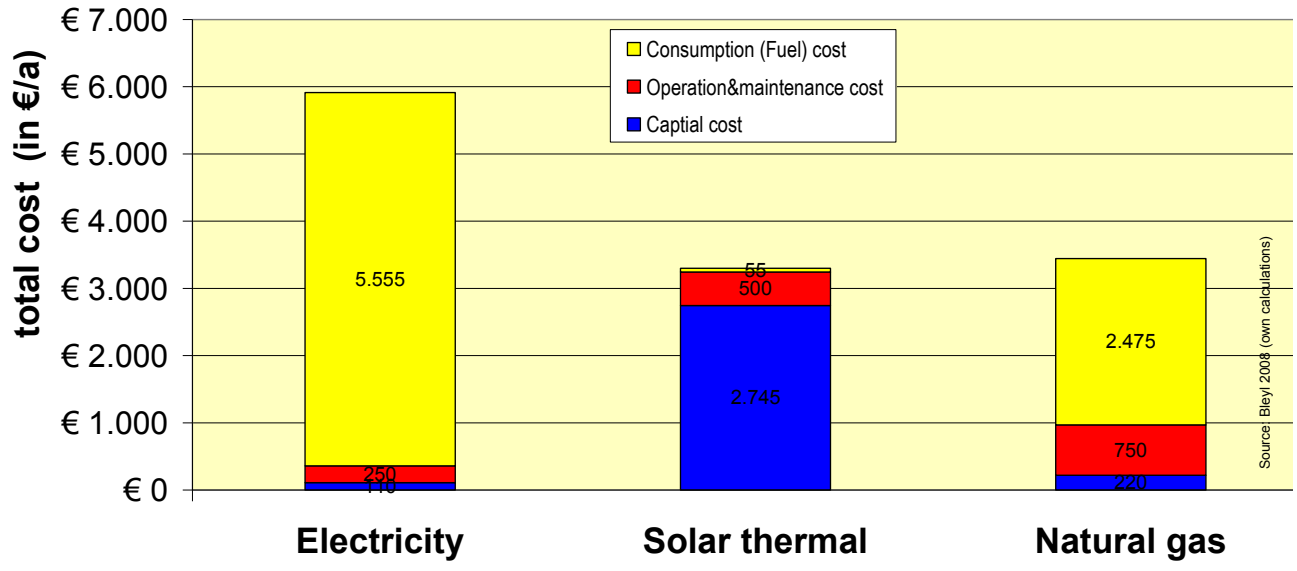
Total cost comparison example: Compact flourescent vs. convent. light bulb



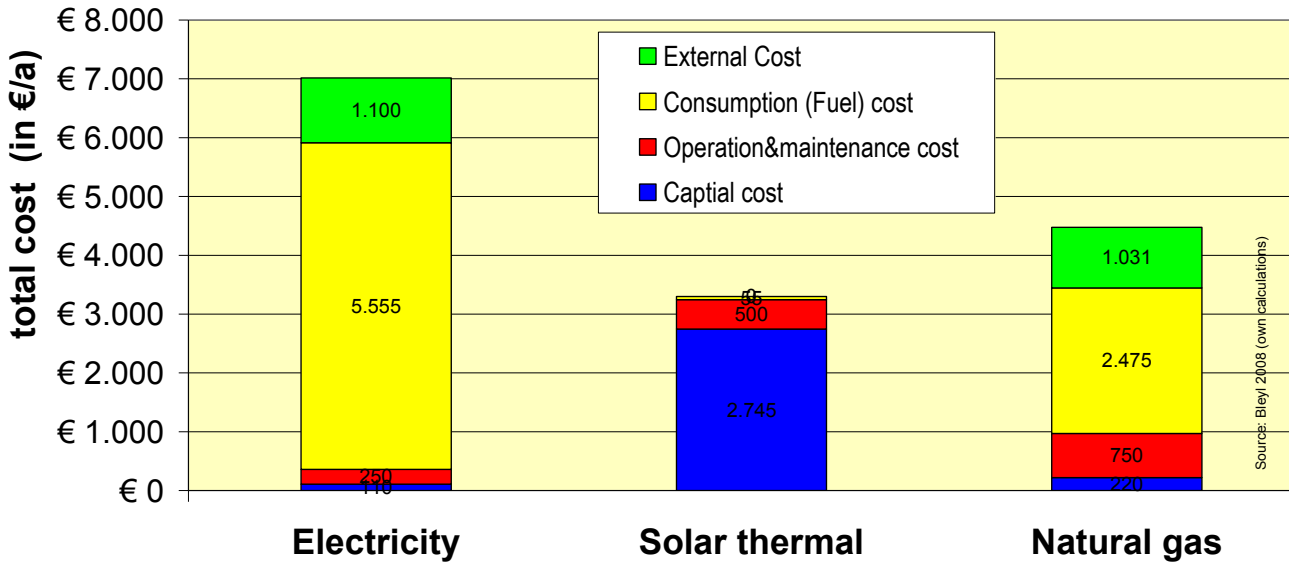
Hot water: Electric vs. Solar vs. Gas
Comparison of Accumulated Total Cost



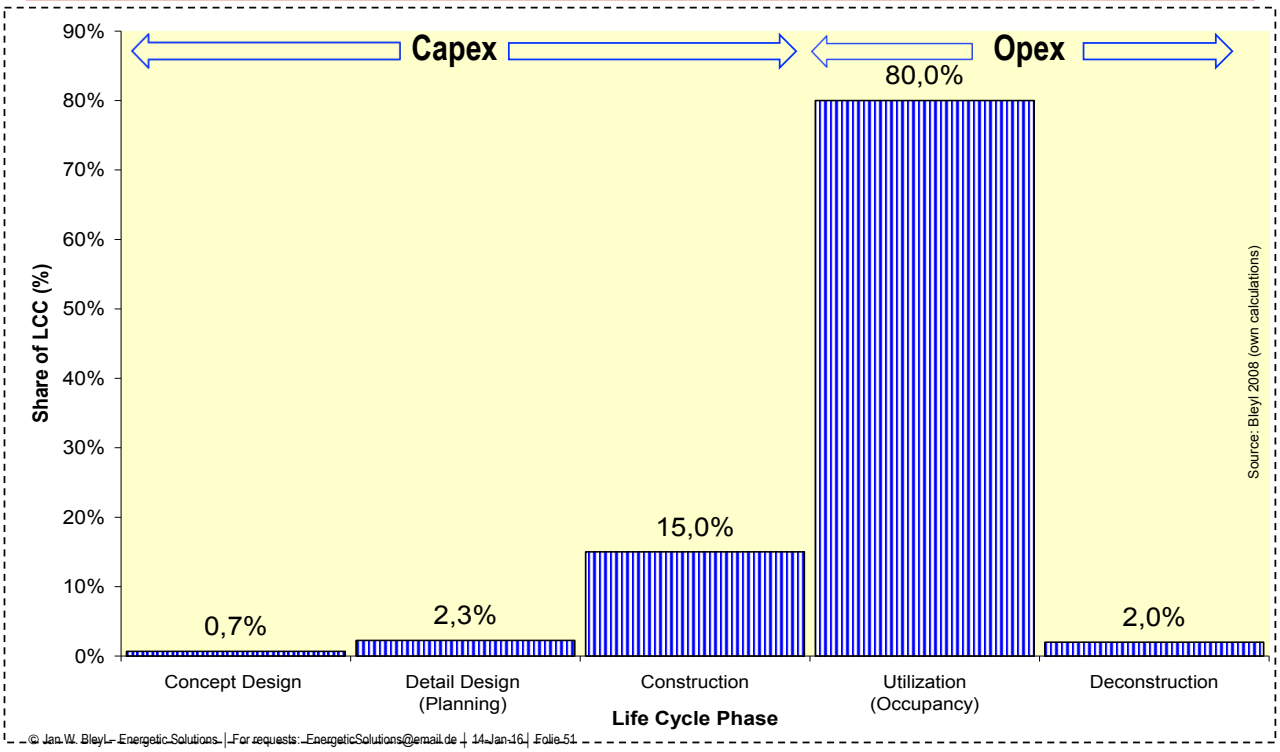
Hot water: Electric vs. Solar vs. Gas
Comparison of Annual Total Cost



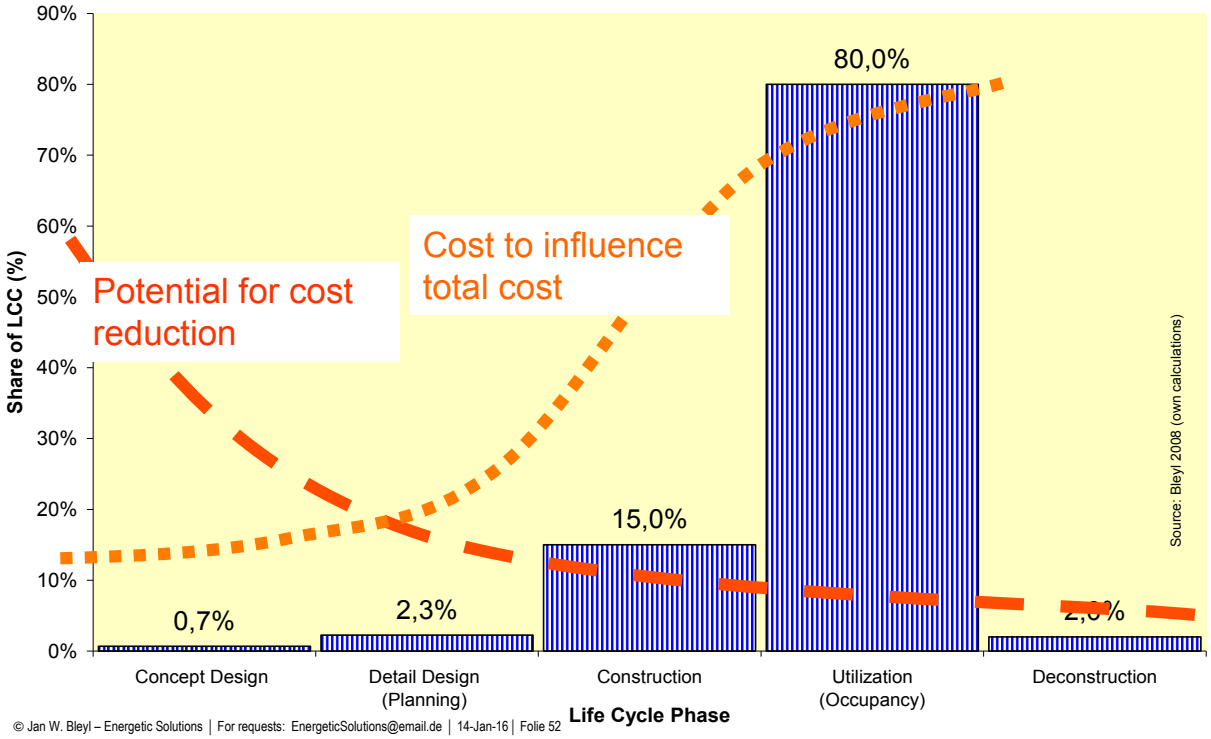
Comparison of Annual Total Cost including Macro Economic Cost



Typcial distribution of cost over life cycle, e.g. building, motor, fan …



Potential and cost to influence Total Cost over Life Cycle of a Building



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Please introduce yourself briefly:

Your experiences, expectations and wishes for this training?

Motivation, goals and tasks of investment calculation
(capital budgeting)

Goals, approach and KPIs

- **Investment calculation** (capital budgeting) is applied in order to evaluate **micro economic profitability** (no external cost)
- Calculation of **financial criteria = key performance indicators** (KPI) from **project** & **equity cash flows** and **profit & loss accounts** by examining **revenues, investments** (CAPEX) and **operational costs** (OPEX) over an entire **project life cycle** (PLC).
- The **comparison of KPIs with company guidelines** enables a decision either in favour or against a certain project or the selection of the most economical investment option / scenario
- Calculations can be done either **prospective** (=> planning) or **retrospective** (=> controlling).

Source: after www.projektmagazin.de

Chosen! calculations parameter, scenarios and profitability criteria

- **Framework conditions** like **price development scenarios** or **project term** but also **minimum KPIs are chosen** (not given)**!**
- A project is profitable, if the **capital invested** is earned through the revenues – **with a minimum expected return on investment** – **during the time frame** of the project.
- Other criteria may be **max**. **payback periods**, **project seize** … as defined by **company guidelines** *(c.f. next slide)*

Source: after www.projektmagazin.de

Key tasks of investment calculations

1. **Compliance** with company guidelines & KPIs, e.g.
   - ✓ **Interest yield target** for committed (equity) capital => IRR, NPV
   - ✓ Max. pay-back period of investment, max total investment
   - ✓ Risk assessment, compliance with **risk-management** guide lines
   - ✓ **Documentation** of decision making processes
2. **Reporting** to **management** and preparation of **financing**
   - ✓ Documentation of **project cash flow** (CF)**, Profit & Loss** (P&L)**, Cash Flow available for debt service** (CFADS, DSCR) **…**
3. Calculation of **proposal parameters**, e.g. for ESCos
   - ✓ **Bidding prices, contract term,** building cost subsidies needed …
4. **Optimization** and **risk management** of projects
   - ✓ Determination of **sensitive/key parameters**
   - ✓ **Scenario calculations**

Others in your company/country?

Basics of dynamic economics calculation and key performance indicators (KPI):
- Time value of money concept
- Project- & equity cash flows (P-CF, E-CF)
- Net present value (NPV)
- Internal rate of return (IRR)
- Payback period (T)

Static vs. dynamic methods

Static ***=> short-term, not capital intensive projects***:

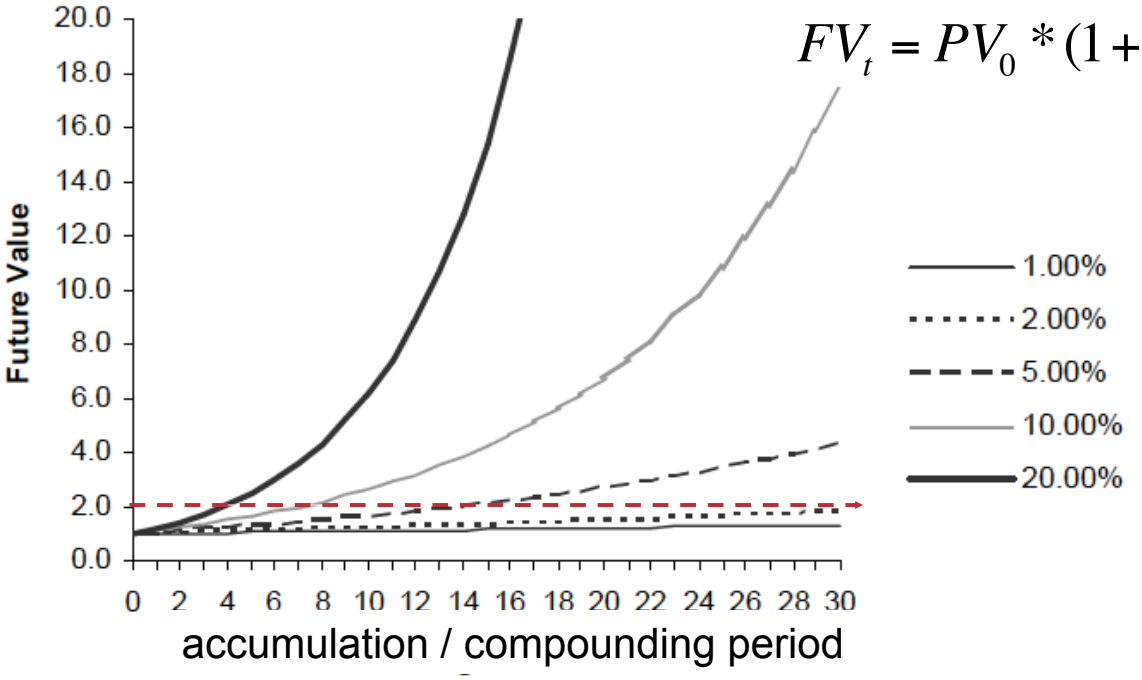
- no consideration of time of payments
  => Neglect of time value of money (and opportunity cost)
- e.g. static payback time; static cost- or profit comparison
- Mostly based on accountancy figures (P&L, e.g. depreciation)

Dynamic ***=> longer-term, capital intensive projects***:

- the time of payment is considered
  => e.g. future payments are worth less in the present
- e.g. Net present value (NPV), Internal rate of return (IRR), Annuity methods
- Based on real cash flows (CF)

Future Value (FV_t): Accumulation of present investments

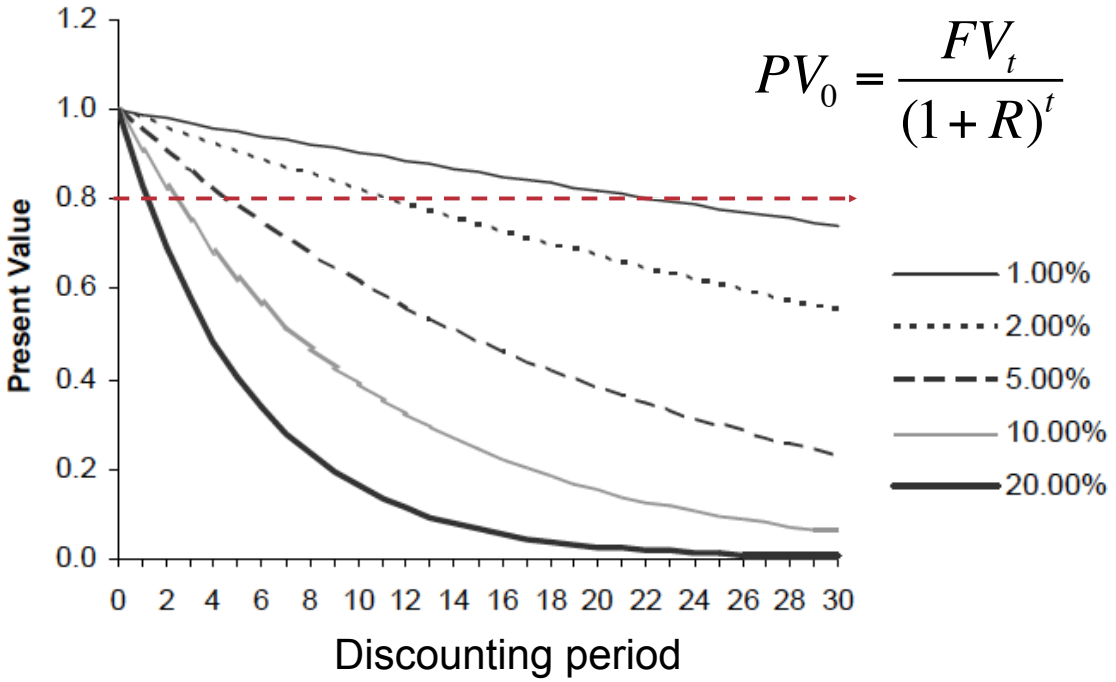
$$FV_t = PV_0 * (1+R)^t$$



Source: after Prof. Dr. Pascal Gantenbein

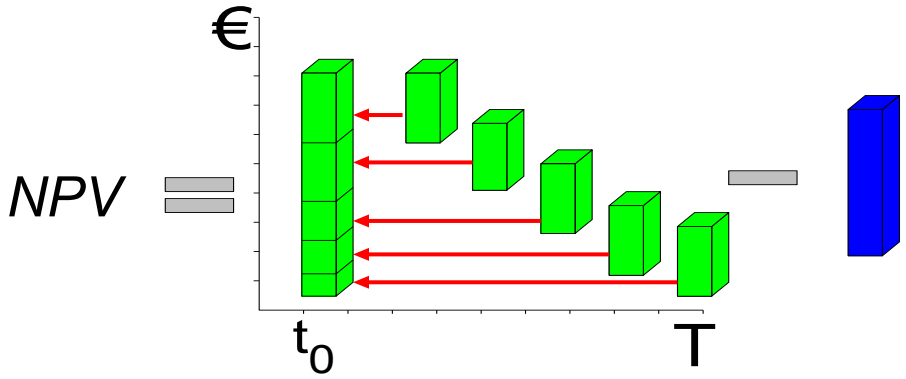
Present Value (PV_0): Discounting of future Cash Flows

$$PV_0 = \frac{FV_t}{(1+R)^t}$$



Source: after Prof. Dr. Pascal Gantenbein

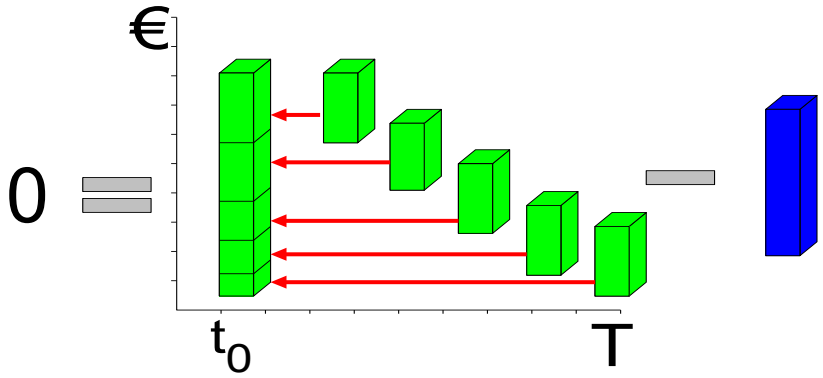
Net Present Value (NPV, capital value) graphic + formula (Excel: NPV)



$$NPV = \left(\sum_{t=0}^{T} \frac{(revenues - expenses)_t}{(1 + discount\_rate(= WACC))^t} \right) - Investment$$

$$..... = \left(\sum_{t=0}^{T} \frac{(profits\_or\_savings)_t}{(1 + discount\_rate(= WACC))^t} \right) - Investment$$

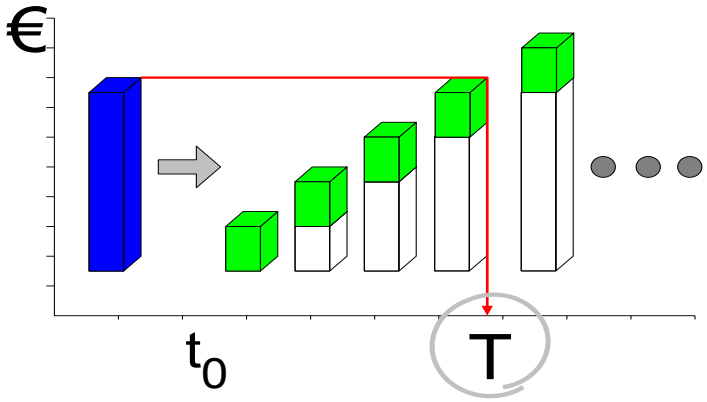
Internal Rate of Return (IRR) – graphic + formula (Excel: IKV)



$$Investment = \left(\sum_{t=0}^{T} \frac{(revenues - expenses)_t}{(1 + IRR)^t} \right)$$

$$..... = \left(\sum_{t=0}^{T} \frac{(profits\_or\_savings)_t}{(1 + IRR)^t} \right)$$

Payback period – graphic + formula



$$static\_Payback\_T = \frac{Investment}{average\_annual\_profit\_or\_savings}$$

$$dynamic\_T : 0 = \left(\sum_{t=0}^{T} \frac{(profits\_or\_savings)_t}{(1 + discount\_rate)^t} \right) - Investment$$

Key performance indicators (KPI) **from Cash Flows** (CF)

From **project** or **equity Cash Flows** (P-CF, E-CF)
(= actual cash flows perspective => no depreciation):

1. **Cash Flow:** annual/monthly => **liquidity** and accumulated CF
2. **Net present value** (NPV) (= capital value)
   (c.f. separate slide for discounting factors)
3. **Internal rate of return** (IRR)
   (discount rate at which NPV of CF = 0!
4. **Dynamic payback period** = time to recover investment
   (Cumulative CF = 0)
5. **CF available for debt service** (CFADS) &
   Debt service coverage ratio (DSCR)

… others in your company / institution?

Discounting factors for NPV calculations and decision criteria

For **net present value** (NPV) **calculations of project or equity cash flows**, the following discounting factors can be applied:

- Weighted average cost of equity and debt capital (WACC))
- **Return on investment alternatives** (e.g. bank account)
- Other **company guidelines**

Decision criteria:

- **NPV ≥ 0**: project is profitable (the expected return on investment is achieved/surpassed)
- **NPV ≤ 0**: project is not profitable

Profit & Loss: Economic criteria and key figures

From Profit & Loss statement (P&L)
(= book-keeping/accounting perspective => static):

1. **Investment volume**
2. + **Revenues** (= sales)
   – **Expenses** (= costs),
   = **Profit** (= earnings) (EBT = before taxes))
   both **annually** (average) and **accumulated** for total duration
3. **Net-profit-ratio** (= profit-turnover-ratio)
   = income / revenue
4. **Return on Investment** (ROI)
   = (income + cost of borrowed capital) / investment
5. **Marginal returns, profit contribution per unit**

… others in your company / institution?

Tutorial

Link to Economics interactive tutorial by Samuel L. Baker, Ph.D., Associate Professor:

1. http://hspm.sph.sc.edu/courses/Econ/Tutorials.html
2. Total Cost, Variable Cost, and Marginal Cost
3. Marginal Cost and the Price-Taking Firm's Optimal Output Rate
4. Average Cost and the Break-Even Output Rate
5. Demand
6. Elasticity
7. Elasticity II

Tutorial (cont.) and further reading

9. Supply, Demand, and Equilibrium
10. Monopoly: Marginal Revenue and the Profit-Maximizing Price and Output Rate
11. Discounting Future Income
12. The Internal Rate of Return
13. Perils of the Internal Rate of Return
14. Risk
15. Risk Aversion and Insurance

Dictionary: http://www.investopedia.com/terms/a/

Group Work Calculation Tool: **Project Cycle Cost of your EE/RES/ESCo project and possible data sources**

Group work: **Project cycle cost and revenues of your EE/RES/ESCo project?**

1. Please **itemize all project cycle cost and revenues** of an Energy / ESCo project – preferably from **your project** in:
   - ⇨ Capital cost (CAPEX)
   - ⇨ Operational cost (OPEX)
2. Can you **quantify** the different items?
3. Please identify possible **sources** of these cost and revenue positions?
4. Which items are the most troubling and difficult to source?
5. Do you wish to present or discus your results?
   Do you have specific issues?

Time frame: **20 minutes preparation, 20 minutes discussion**

COP 21: Leaders celebrate agreement
How hopeful are you?

Secretary-General Ban Ki-moon (second left); Christiana Figueres (right), Executive Secretary of the UN Framework Convention on Climate Change (UNFCCC); Laurent Fabius (second right), Minister for Foreign Affairs of France and President of the UN Climate Change Conference in Paris (COP21) and Franois Hollande (right), President of France celebrate

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Investment / ESCo calculation tool:
Liability exclusion, user agreement and NDA

Investment / ESCo calculation tool spreadsheet: **Exclusion of liability, user agreement, NDA**

1. The present Excel calculation tool was developed with the highest dilligence possible for GIZ training purposes only. It is not a commercially distributed software with a support hotline.
2. The present tool may be used for own purposes within your company. A partial or complete distribution to third parties, no matter if free of charge or subject to charges is not permitted.
3. Liability for any information or calculation results is not assumedby the organizer of the training course or the tool developper Mr. Jan W. Bleyl.
4. It is within the duty of the user to check the plausibility and correctness of the calculation results by professional verification.
5. **By utilizing of the tool, the user accepts this exclusion of liability, user and non-disclosure agreement (NDA)**

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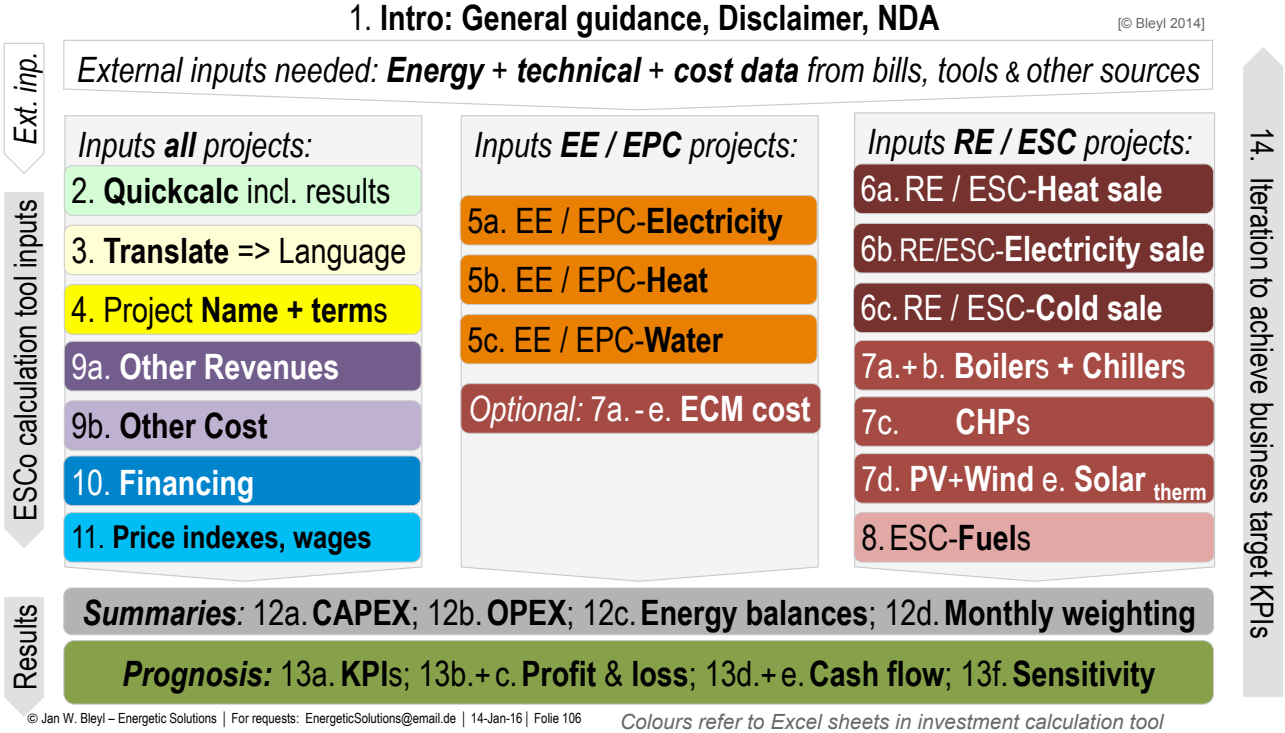
Introduction to the Investment / ESCo Calculation Tool

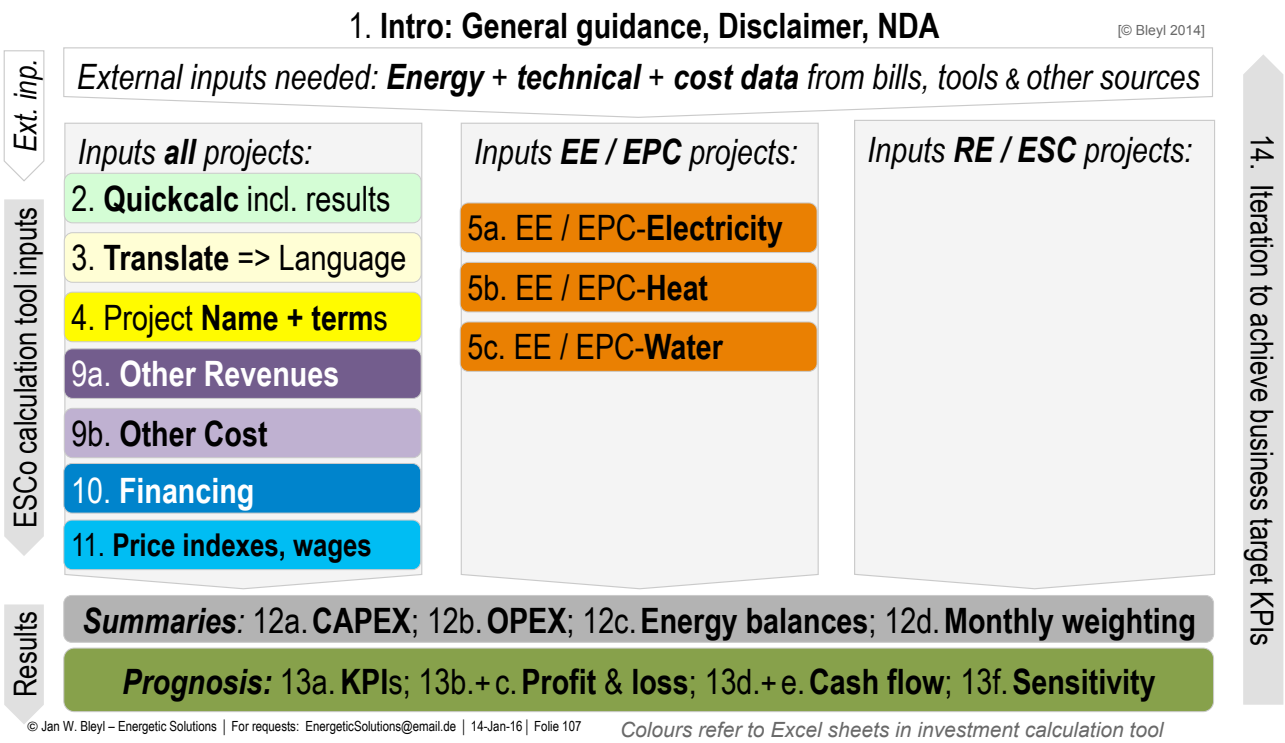
Tool takes an Investor's perspective: Either an in-house/own investment or through an external ESCo

Investment / ESCo Calculation Tool: **Structure + Work Flow steps 1.-14.**



Colours refer to Excel sheets in investment calculation tool

Investment / ESCo Calculation Tool:
Training focus Jordan_Sept. '15



Colours refer to Excel sheets in investment calculation tool

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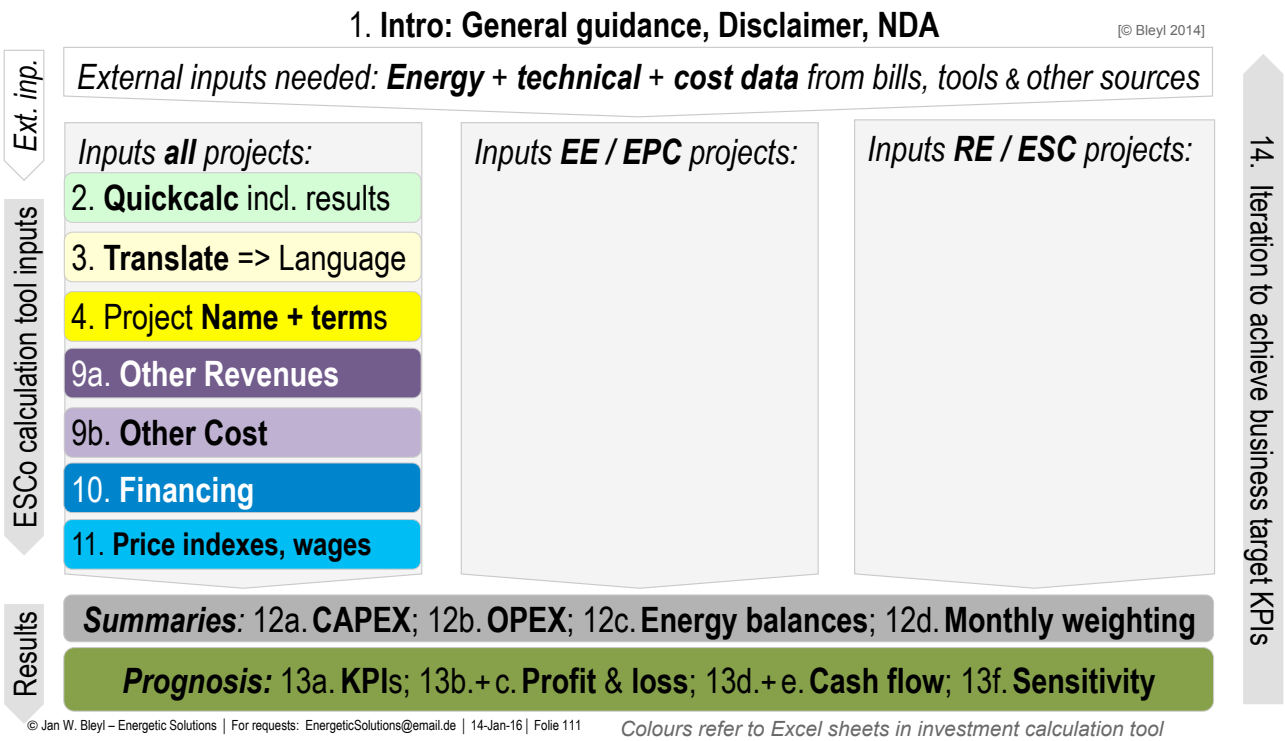
Introduction to the Investment / ESCo Calculation Tool

=> *Many more details in Handbook*

Invest./ESCo calculation tool
GIZ Manual / Handbook overview

1. General **introduction, disclaimer** and **NDA**
2. **Description of each spreadsheet** (2a – 13f):
   - ⇨ Goals and functionalities
   - ⇨ Input and output data & charts
   - ⇨ Further comments and explanations
3. **Excel know how**:
   - ⇨ Decimal and thousands separator & worksheet settings
   - ⇨ Goal seek analyses,
   - ⇨ Keeping standard/default values (in green cells)
4. **Example projects**:
   - ⇨ EPC: Re-lighting
   - ⇨ ESC: Agricultural CHP

Investment / ESCo Calculation Tool:
General work sheets 1.-4. + 9.-13.



Colours refer to Excel sheets in investment calculation tool

Invest./ESCo calculation tool spreadsheets:
1. Title + Introduction

Title: **Investment-grade calculation, forecasting** & **analysis** of comprehensive **ESCo projects**
(for EPC and ESC business models).
Economic, financial and technical calculation tool

1. **„Preliminary remarks“**– general advice for the operation of the calculation tool
2. **Exclusion of liability** – own responsibility for results. Professional verification necessary.
3. **Terms of use** – use in own company, no disclosure to third parties (neither for free nor with compensation)
4. **Tool interfaces**: Baseline costs, savings potentials, CAPEX and OPEX etc. are needed input data for the tool from other sources

Invest./ESCo calculation tool spreadsheets:
3. Translate

Goals and functionalities:

1. **„3. Translate“** spreadsheet contains all cell text and its translations for entire Excel tool
2. Selection of language and currency units in sheet 4
3. Option to add additional currencies

Remarks:

✓ Hyperlink navigation between Excel spreadsheets

Invest./ESCo calculation tool spreadsheets:
4. Name + term

Goals and functionalities:

1. Selection of **project type, energy carriers, detailed results** ...
2. Selection of **language** and country specific **energy** and **currency units**=> dropdown menues
3. *Data input* for **project name** incl. calculation version
4. *Data input* for **project start and end** (year + month)
5. *Data input* for **start of service provision** (year + month)
6. *Data input* for **end of depreciation period** (year + month) if not equal to project termination

Remarks:

✓ Project name will be printed on each spreadsheet automatically

Invest./ESCo calculation tool spreadsheets:
9a-b. Other revenues + cost

Goals and functionalities:

1. *Data input* for **other revenues** (e.g. subsidy payments after investment, residual values at contract end, from CO_2-certificates or others (*input as annual flat rates*).
2. *Data input* for **other equipment cost** (without outputs):
   Capex: Investment, planning and in-house personal cost
   Opex: In-house personal cost for O&M + invoicing. external cost for O&M, chimney sweep, rents, communication, insurance, others

Invest./ESCo calculation tool spreadsheets:
10. Financing

Goals and functionalities:

1. *Data input* for **subsidies** or building cost subsidies (*input separately per group of measures*)
2. *Data input* for **debt** / **borrowed capital**: financing shares, interest rates, disagio, beginning and end of repayments ... for up to 4 different loans + 1 annuity loan
3. *Data input* for **equity capital** (calculatory interest rate): => Weighted average cost of captital (WACC) for discount factor
4. *Output figure: CFADS, DSCR, LLCR*
5. *Output data:* Calculation of **interest, installment repayments**, **remaining obligations** for each loan and their totals over entire project term

Invest./ESCo calculation tool spreadsheets:
11. Price indexes (for all sheets)

Goals and functionalities:

1. *Data input* for all **cost and price developments** over entire project term (*inputs as annual percentage increase*) for:
   - ⇨ Wages and maintenance cost indexes
   - ⇨ EPC: Baselines indexes
   - ⇨ ESC: Fossile and renewable energy cost indexes
   - ⇨ …
2. *Data input* for **in-house hourly wages** and **cost increases** for own personal. Separate for project development, construction management, technical operation management, M&V and invoicing personal
3. *Output data: Index and cost development* over project term

Invest./ESCo calculation tool spreadsheets:
12a-b. Summary of cost inputs

Goals and functionalities:

1. **Verification of all entries for all cost items** (Capex + opex) for the entire length of the project (project cycle costs)

Remarks:

- ✓ **Energy balance for all energy sources**: energy, heat, fossil fuels and biomass
- ✓ Calculation of annual months of operation for all plant components
- ✓ No data entry

Invest./ESCo calculation tool spreadsheets:
13a.-e. Results and Prognoses

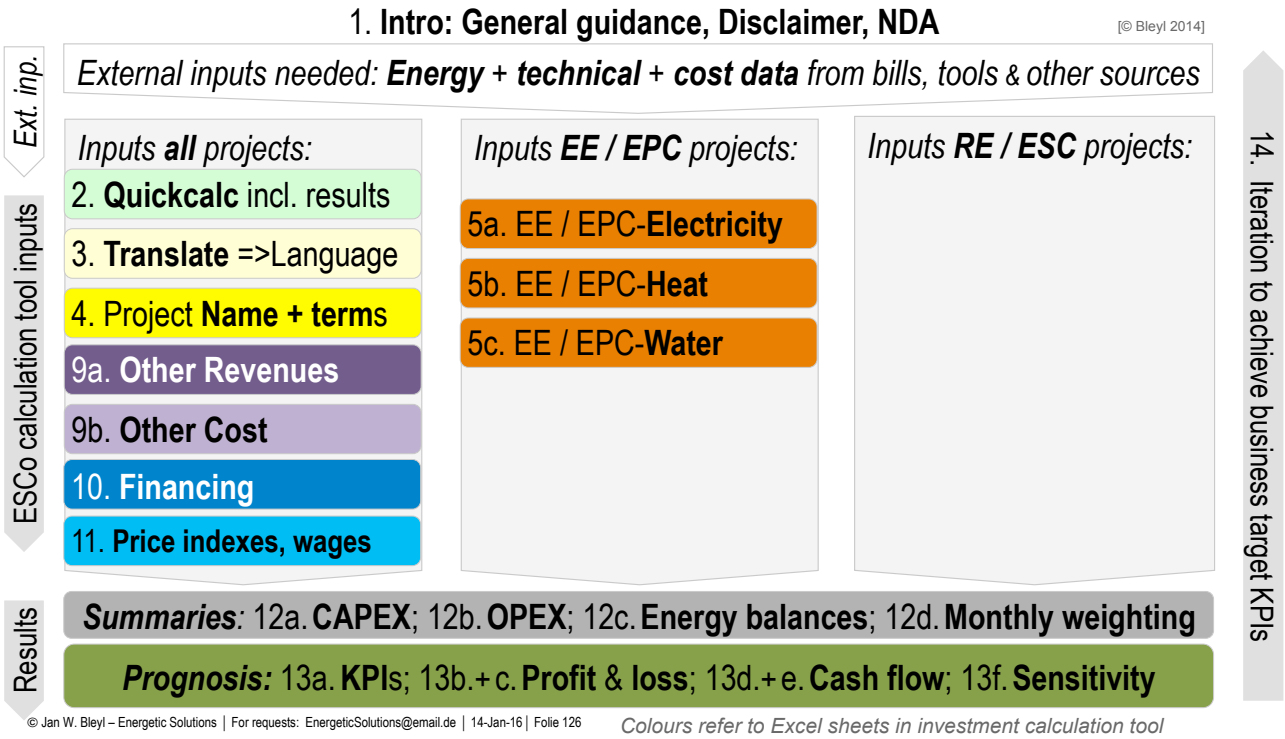
Goals and functionalities:

1. **KPIs, results and prognoses**
2. ”14. **Iteration to achieve business target KPIs**”
   => **change of input data**

Remarks:

- ✓ 13a. „**Key performance indicators**“ – summery of the (projected) economic viability of the project in key figures
- ✓ 13b. **Profit and lost statement** (P/L, = book-keep.) figure + table
- ✓ 13d. **Project and equity Cash-Flows and liquidity forecast** figure + table
- ✓ 13f. **Sensitivity analyses** – graphic and tables

Investment / ESCo Calculation Tool:
EPC Work Flow steps 1.-5. + 9.-14.



Colours refer to Excel sheets in investment calculation tool

ESCo calculation tool spreadsheets:
"5a-c. EE/EPC-Electricity, Heat, Water"

Goals and functionalities:

1. *Data input* for **energy cost baselines:**
   All cost components for up to 10 different clients
2. *Data input* for **energy savings** (all cost components):
   %-savings of baseline for all cost components for up to 10 different measures *(bottom up check recommended!)*
3. *Data input* for **project cycle cost of EPC measures**:
   Capex: Investment, planning and in-house personal cost ...
   Opex: 1. In-house: personal cost for O&M + M&V
   2. External cost for O&M, insurance, others
4. *Data input:* **Baseline adjustments** and **revenue sharing**
5. *Output figure + data:* **Calculation of baseline** and **savings revenue development** over entire project term

Results and outputs of investment-grade economics calculation
(based on calculation tool):

EPC Example

Industrial Re-lighting
EE / EPC project

Industrial Re-lighting EE / EPC project:
Key calculation parameters

***Project outline**:*

- ✓ Schedule: Start: **01/2015**; contract term: **4.5 y.;** construct.: **1** month
- ✓ Light before: **348 x 500 W** metal halide fixtures
- ✓ ECM measure: Replace by **500 x 100 W** LED fixtures
- ✓ Operating hours: **5,400** hours/year (flat rate, except for year 1: **4,500** h)

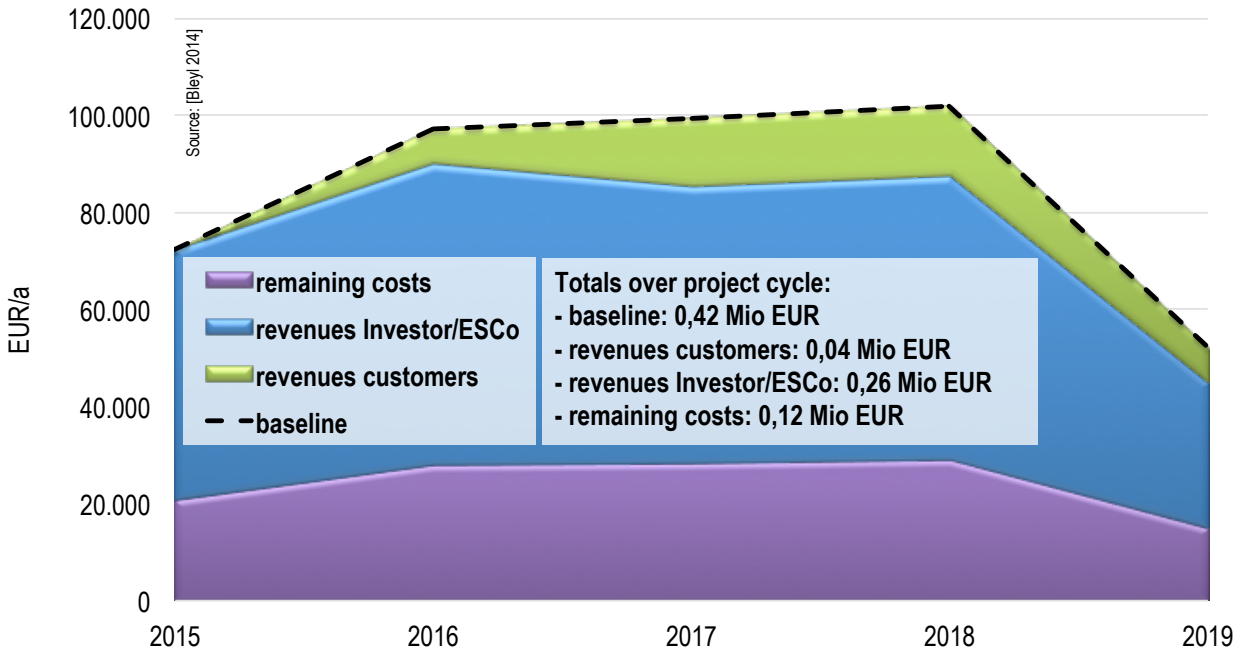
***Electricity baseline + operating cost** and **price increases**:*

- ✓ Electricity: **115** EUR/MWh (35%), low tarif: **85** EUR/MWh
- ✓ Power: **28.5** EUR/kW/year
- ✓ O&m: **1.5 %/a** of investment (external) + **10** h/a personal (in-house)
- ✓ Price increases: Electricity: **2.5** %/year, others: **2** %/year

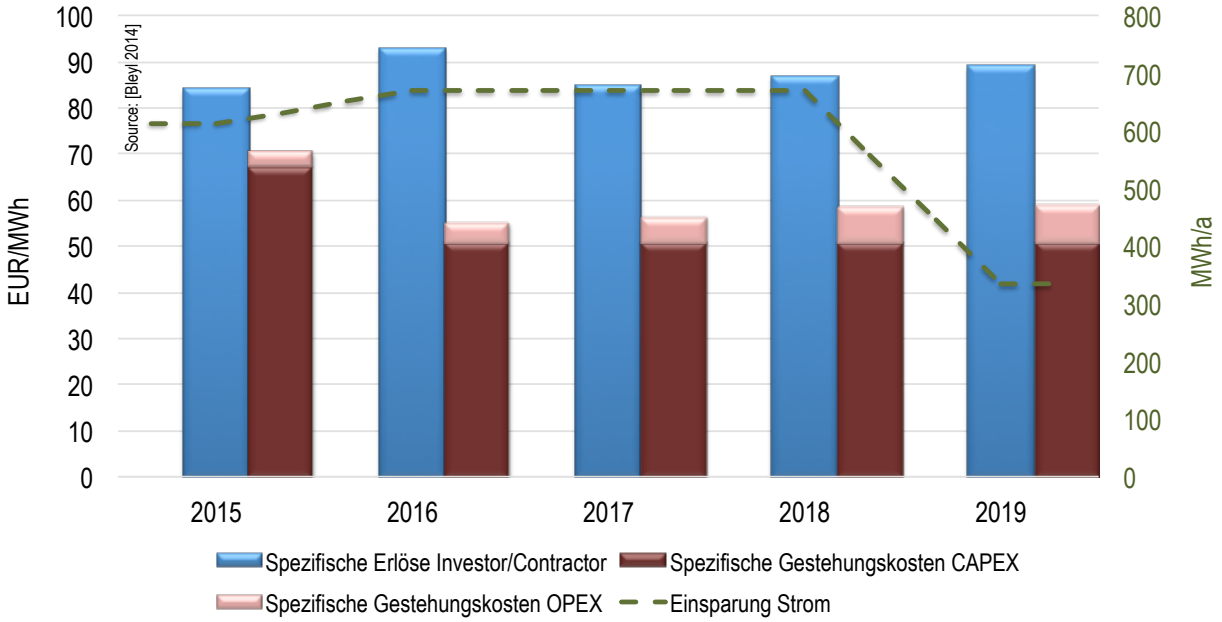
***Investment, financing** and **revenue sharing**:*

- ✓ Investment: **380**,- EUR/fixture + planning: **8,500** EUR + **80** h à **75** EUR/h in-house
- ✓ Subsidies: **20** % of investment (cash flow in second year)
- ✓ Equity share: **25 %** at **11 %** interest
- ✓ Borrowed capital: **5.5 %** interest, 4 repayments/year
- ✓ Savings share ESCo: year 1: **100** %, year 2: **90** %, year 3 et sqq.: **80** %

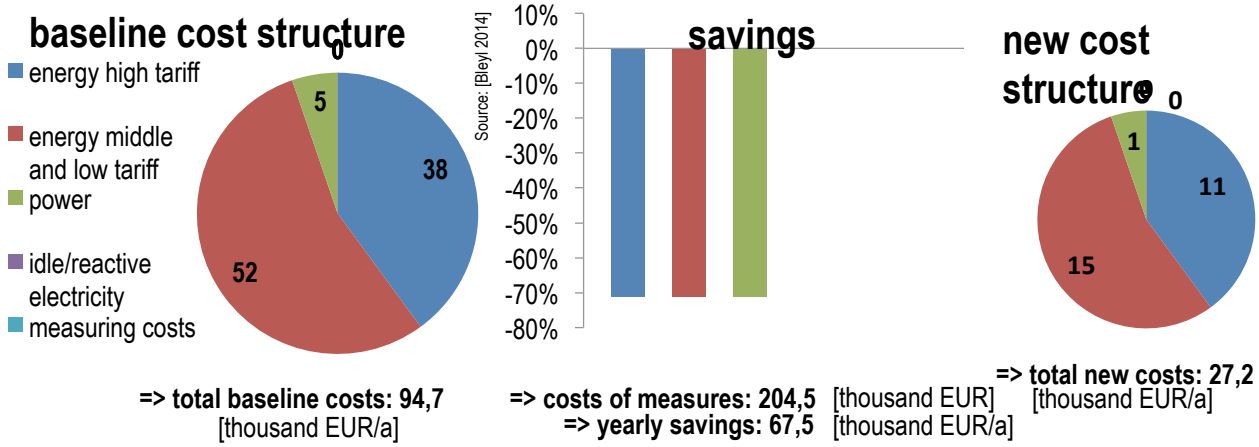
Baseline, revenues client, ESCo and cost after savings measure (ECM)



Savings generation cost and revenue development



Baseline cost structure, savings and new cost structure

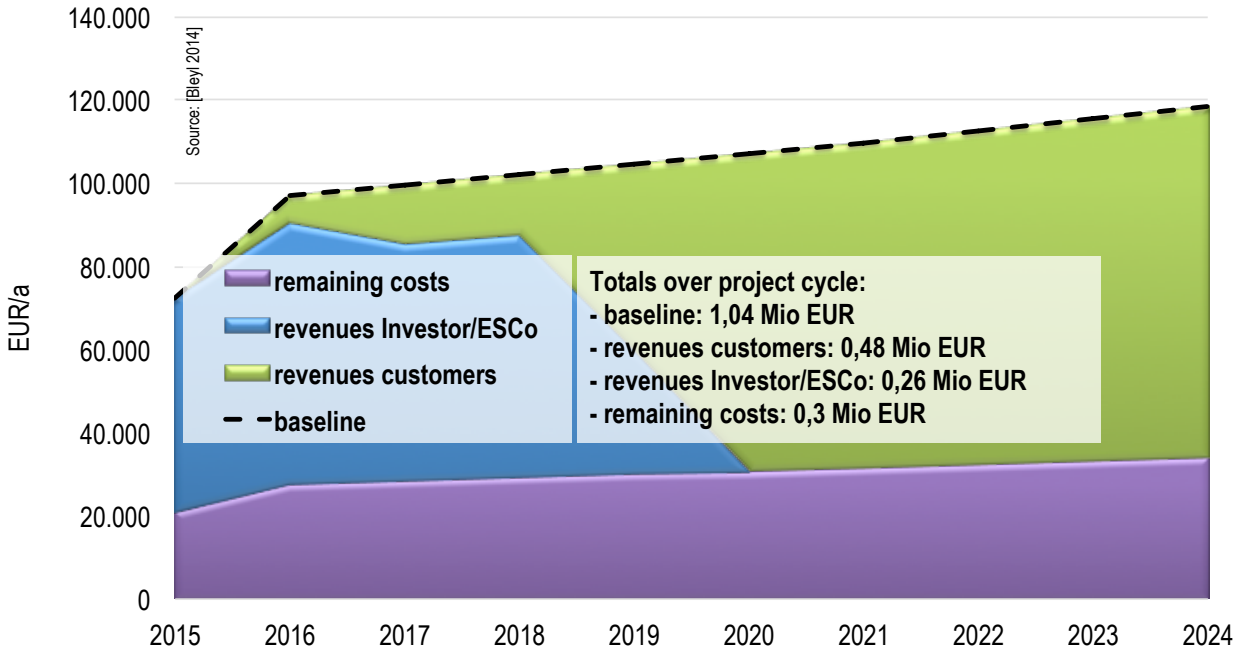


=> total baseline costs: 94,7 [thousand EUR/a]

=> costs of measures: 204,5 [thousand EUR]
=> yearly savings: 67,5 [thousand EUR/a]

=> total new costs: 27,2 [thousand EUR/a]

Baseline and clients share of savings during and after contract over 10 years



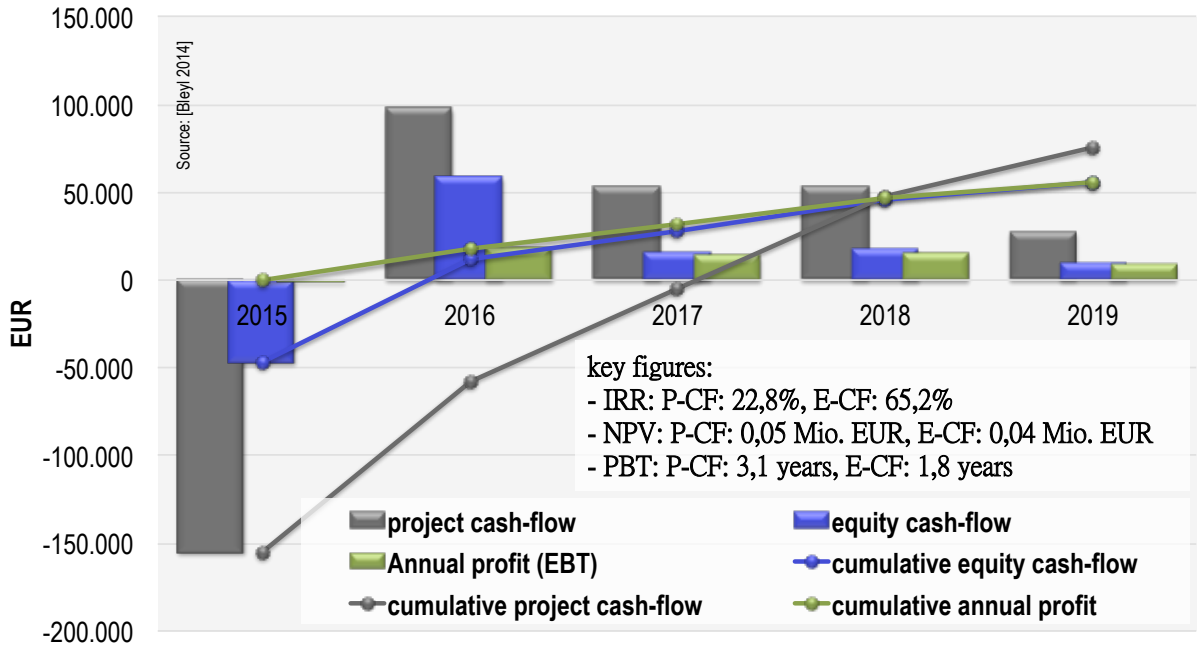
Cash Flow and Liquidity Forecast

	unit	cumulative	average (mean)	2015	2016	2017	2018	2019
investment								
equity capital	EUR	11.625	-	49.625	-38.000	0	0	0
investment costs	EUR	198.500	-	198.500	0	0	0	0
subsidies/construct cost grants	EUR	38.000	-	0	38.000	0	0	0
loan disbursement	EUR	148.875	-	148.875	0	0	0	0
interest + payment (debt capital)	**EUR**	**168.322**	**37.405**	**40.589**	**38.770**	**36.950**	**35.130**	**16.883**
loan payment	EUR	148.875	33.083	33.083	33.083	33.083	33.083	16.542
interest on debt capital	EUR	19.447	4.322	7.506	5.686	3.867	2.047	341
sum of sales revenues from regular operation	**EUR**	**258.447**	**57.433**	**51.548**	**62.251**	**56.718**	**58.136**	**29.794**
electricity savings	EUR	258.447	57.433	51.548	62.251	56.718	58.136	29.794
heating savings	EUR	0	0	0	0	0	0	0
water savings	EUR	0	0	0	0	0	0	0
heat sale	EUR	0	0	0	0	0	0	0
cooling sales	EUR	0	0	0	0	0	0	0
sale of electricity to customers	EUR	0	0	0	0	0	0	0
sale of electricity to electric utility	EUR	0	0	0	0	0	0	0
misc. revenues	EUR	0	0	0	0	0	0	0
sum of costs from regular operation	**EUR**	**22.614**	**5.025**	**7.994**	**2.865**	**3.745**	**5.291**	**2.720**
purchasing of final energy	EUR	0	0	0	0	0	0	0
internal staff costs	EUR	9.435	2.097	6.688	765	780	796	406
misc. operating costs (external)	EUR	13.179	2.929	1.306	2.100	2.965	4.495	2.314
misc. costs	EUR	0	0	0	0	0	0	0
project cash-flow	**EUR**	**75.333**	**16.741**	**-154.946**	**97.387**	**52.972**	**52.845**	**27.075**
equity cash-flow	**EUR**	**55.886**	**12.419**	**-46.660**	**58.617**	**16.022**	**17.715**	**10.192**
cumulative project cash-flow	**EUR**	**-**	**-**	**-154.946**	**-57.559**	**-4.587**	**48.258**	**75.333**
cumulative equity cash-flow	**EUR**	**-**	**-**	**-46.660**	**11.957**	**27.979**	**45.694**	**55.886**
Cash Flow Available for Debt Service	**EUR**	**235.833**	**52.407**	**43.554**	**59.387**	**52.972**	**52.845**	**27.075**
Debt Service Coverage Ratio	**-**	**-**	**-**	**1,1**	**1,5**	**1,4**	**1,5**	**1,6**

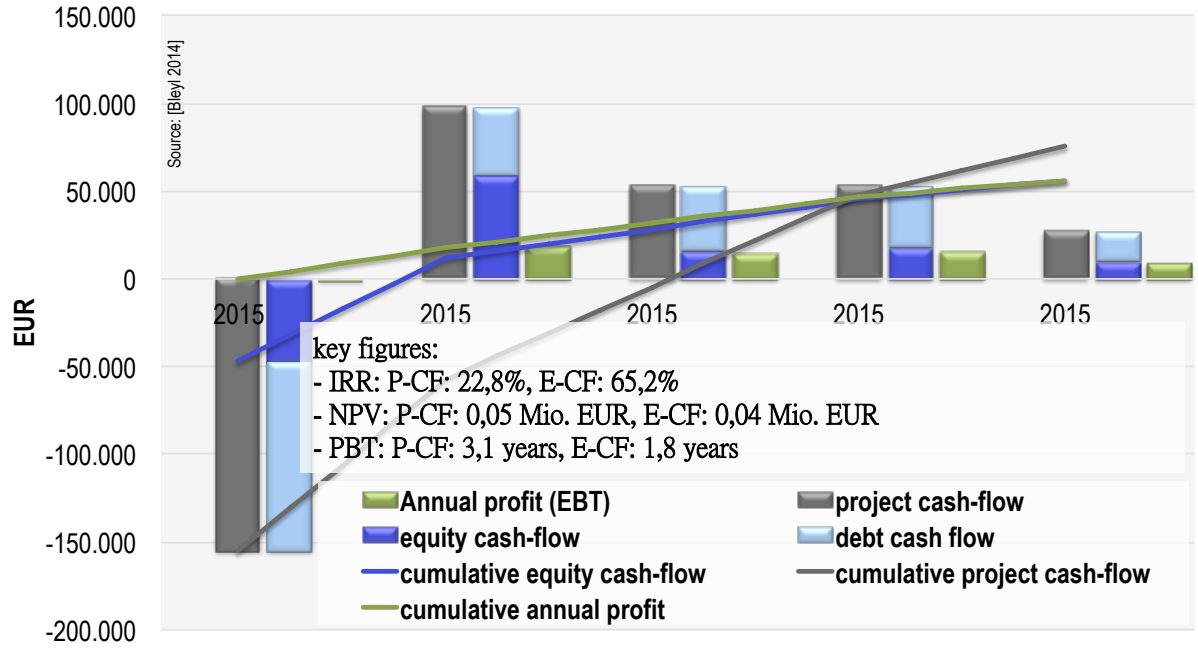
Profit & Losses (accounting)

	unit	cumulative	AVERAGE (mean)	2015	2016	2017	2018	2019
investments	EUR	204.500	-	204.500	0	0	0	0
construction (incl. internally produced and capitalized assets)	EUR	204.500	-	204.500	0	0	0	0
revenues	EUR	302.447	67.210	57.548	73.108	67.575	68.993	35.223
sales revenues from	EUR	258.447	57.433	51.548	62.251	56.718	58.136	29.794
electricity savings	EUR	258.447	57.433	51.548	62.251	56.718	58.136	29.794
heating savings	EUR	0	0	0	0	0	0	0
water savings	EUR	0	0	0	0	0	0	0
heat sale	EUR	0	0	0	0	0	0	0
cooling sales	EUR	0	0	0	0	0	0	0
sale of electricity to customers	EUR	0	0	0	0	0	0	0
sale of electricity to electric utility	EUR	0	0	0	0	0	0	0
misc. revenues	EUR	0	0	0	0	0	0	0
capitalized internally produced assets	EUR	6.000	1.333	6.000	0	0	0	0
misc. operational yields (construction cost grants activated)	EUR	38.000	8.444	0	10.857	10.857	10.857	5.429
expenditure	EUR	246.561	54.791	57.943	54.853	53.914	53.639	26.212
purchasing of final energy	EUR	0	0	0	0	0	0	0
natural gas	EUR	0	0	0	0	0	0	0
biomass	EUR	0	0	0	0	0	0	0
electricity	EUR	0	0	0	0	0	0	0
district heating	EUR	0	0	0	0	0	0	0
misc. raw materials, auxiliary materials and operating materials	EUR	0	0	0	0	0	0	0
misc. costs	EUR	0	0	0	0	0	0	0
internal staff costs	EUR	9.435	2.097	6.688	765	780	796	406
depreciation	EUR	204.500	45.444	42.443	46.302	46.302	46.302	23.151
misc. operating costs	EUR	13.179	2.929	1.306	2.100	2.965	4.495	2.314
interest costs	EUR	19.447	4.322	7.506	5.686	3.867	2.047	341
Annual profit (EBT)	EUR	55.886	12.419	-395	18.256	13.661	15.353	9.011

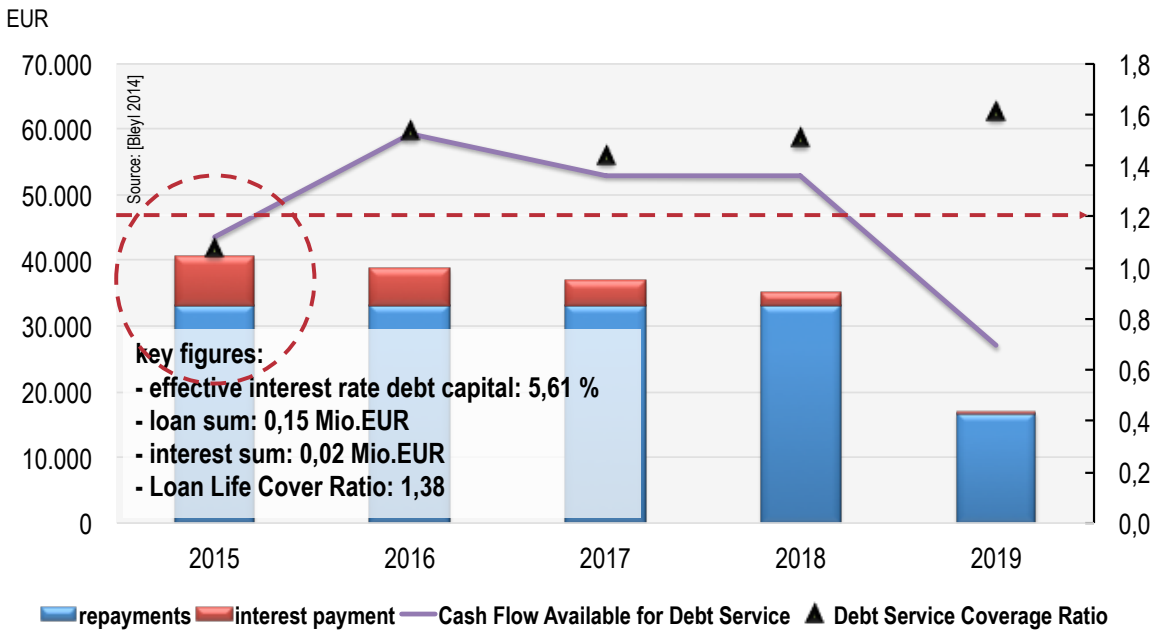
Project & Equity Cash Flows, Profits (EBT) (annual + accumulated)



Project, Equity, Debt Cash Flows & Profits (EBT) (annual + accumulated)



Financing: Debt service, CFADS & DSCR



Detailed **EE / EPC / Savings** calculation example:

Investment / ESCo Calculation Tool: **EE/EPC Work Flow Savings example**

1. **Intro: General guidance, Disclaimer, NDA** [© Bleyl 2014]

Ext. inp. — *External inputs needed:* ***Energy*** + ***technical*** + ***cost data*** *from bills, tools & other sources*

ESCo calculation tool inputs

*Inputs **all** projects:*	*Inputs **EE / EPC** projects:*	*Inputs **RE / ESC** projects:*
3. **Translate** => Language	5a. EE / EPC-**Electricity**	
4. Project **Name + terms**		
10. **Financing**		
11. **Price indexes, wages**		

Results

***Summaries**:* 12a. **CAPEX**; 12b. **OPEX**; 12d. **Monthly weighting**

Prognosis: 13a. **KPIs**; 13b.+c. **Profit & loss**; 13d.+e. **Cash flow**; 13f. **Sensitivity**

14. Iteration to achieve business target KPIs

Colours refer to Excel sheets in investment calculation tool

Thailand: Energy Efficiency in the Food Industry

Energy Conservation Measure (ECM):

1. Replacement of inefficient compressed air system by new compressors, air leakage control
2. Replace Auto mechanic drain with “zero loss” electronic drain

EE Food Industry: Compressor & el. drain

Project outline:

- ✓ Schedule: Start: 01/2017; contract term: 5 years

Electricity baseline, prices and price increases:

- ✓ Compressed Air Sys.: 406 kW before ECM , replaced by 387 kW compressor, operating hours before 6,000 h/a and after ECM 4,000 h/a commencement of savings: 05/2017
- ✓ Mechanic drain: 57,472 kWh/yr Energy losses from 15 sets of float drain ECM: replaced by “Zero loss“ electronic drain -> 100% savings commencement of savings: 10/2017
- ✓ Electricity price: 3.58 THB/kWh
- ✓ Price increases: Electricity: 2,5 %/year, others: 2 %/year

Investment, + operating cost, financing and and revenue sharing:

- ✓ Investment (CAPEX): new compressor: 5,600,000 THB “Zero loss“ electronic drain: 675,000 THB
- ✓ O&M compressor: 80 h/a 1st year , 2nd and following years 60 h/a á 400 THB/h (internal) + 10 % of invest per year (external)
- ✓ OPEX electronic drain: 1st year 7 %, 2nd and following years 5 % of invest (internal) + 3 % of invest per year (external)
- ✓ M&V + accounting: 12h/a á 600 THB/h (internal) for all measures
- ✓ Equity share: 20 % at 12 % interest
- ✓ Borrowed capital: 8 % interest, 4 repayments/year
- ✓ Savings share ESCo: year 1: 80 %, year 2: 80 %, year 3 et sqq.: 70 %

Group Work Calculation Tool: **Own Calculation of Example EE/ EPC /Savings project (industrial Re-lighting or regional)**

in co-operation with: ieadsm energy efficiency Task 16 "Energy Services" www.ieadsm.org

Energy Policy and Planning Office MINISTRY OF ENERGY

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ENERGETIC SOLUTIONS
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Day 2

Investment-grade Calculation, Analysis & **Financing** of **Energy Projects** *(Focus on Energy Performance Contracting)*

Introduction & Hands-on Training

Jan W. Bleyl, Energetic Solutions & IEA DSM Task 16
Simon Zellner, GIZ
Bangkok, Thailand, January 2016

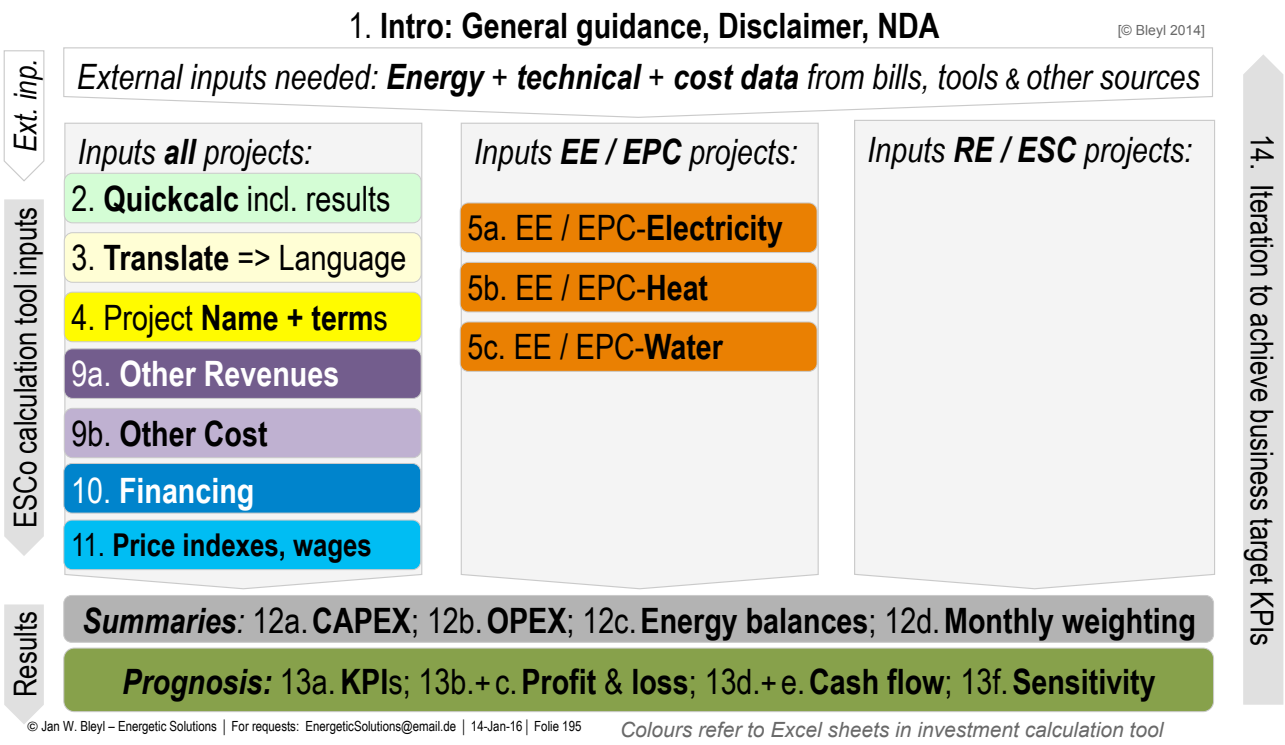
Calculation Training_Thailand
Agenda_Tuesday 19/01/16_Summary

When	*Topic*	*Who*
09:00	Introduction to TGP-EEDP and the training	Dr. Beerepoot
09:10	Training goals and agenda Introduction of life cycle cost concept	Bleyl
09.40	Personal introductions of participants. Your wishes and expectations for the training?	Participants
10:00	*Break*	
10:15	Basics of dynamic economics calculation for ESCo/EE/RES projects	Bleyl
11:30	*1. Group work:* Cost components + data sources of your projects?	Participants
12:00	*Lunch*	
13:00	Calculation Tool: Liability exclusion and NDA Intro to calculation tool + manual => *focus RES, savings model (EE)* Joint calculation of EE project example *(re-lighting, PV or other?)*	Bleyl Bleyl Zellner
14:30	*Break*	
14:45	*2. Group work:* Own Calculation + presentation & discussion of example incl. financing ... Q&A	Participants + Zellner & Bleyl
16:00	*End of day 1 (agenda adjustments possible, subject to training needs)*	

Calculation Training_Thailand
Agenda day 2_Wednesday 20 Jan. `16

When	*Topic*	*Who*
09:00	Summary of calculation tool and Q&A from previous day *3. Group work:* Calculation of own EE projects *(or other examples)*	Bleyl Participants
10:30	*Break*	
10:45	*3. Group work (cont'd)* => Presentation & discussion of results, incl. KPIs, CFADS, financial engineering, parameter sensitivity ... Q/A	Participants + Zellner & Bleyl
12:00	*Lunch*	
13:00	Manual and automatic sensitivity analyses with calc.-tool	Bleyl
13:45	„Quickcalc": Intro and PV example	Bleyl *or* Zellner
14:30	*Break*	
14:45	Deepening of selected training topics based on participants project calculation examples	Participants + Bleyl + Zellner
16:00	*End of day 2 (agenda adjustments possible, subject to training needs)*	

Investment / ESCo Calculation Tool: **Summary**



Colours refer to Excel sheets in investment calculation tool

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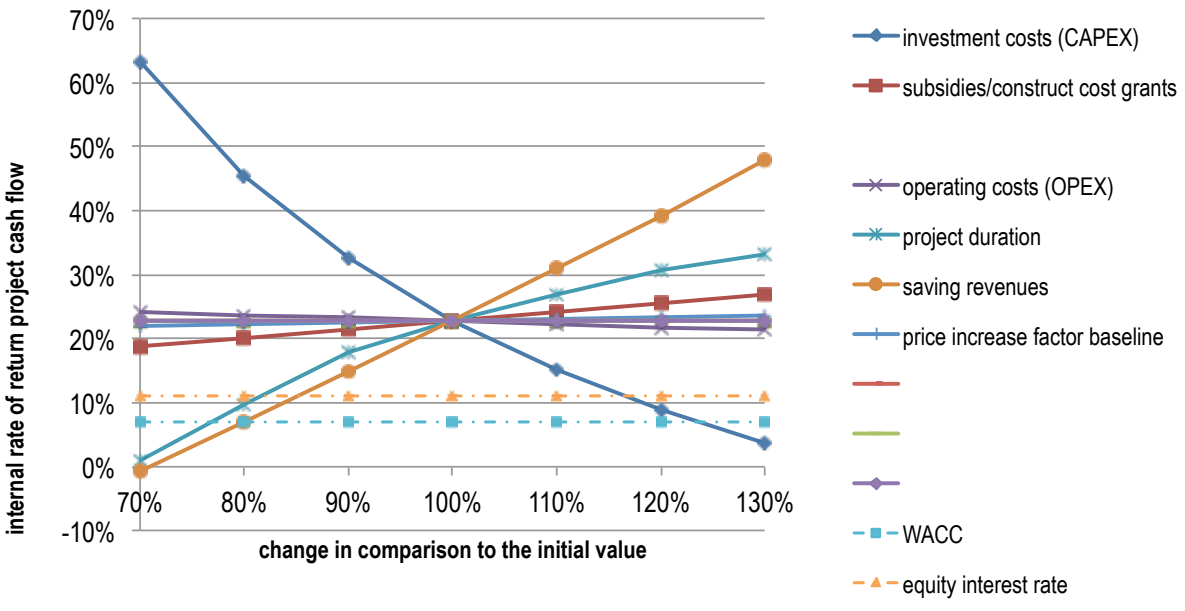
Group Work Calculation Tool: **Calculation of your own EE / EPC or RE/ESC project examples**

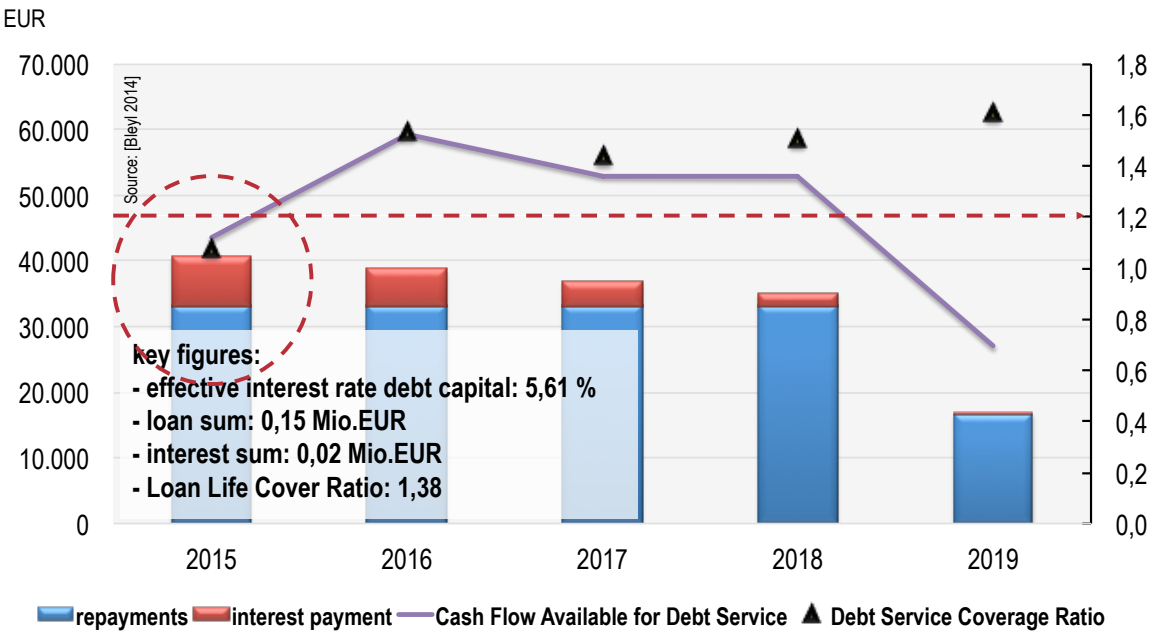
Presentation and discussion of results

Threshold or break-even analyses, target-value-search, sensitivity analyses e.g. for:
- energy cost savings,
- price developments,
- investment costs,
- time of payment of subsidies,
- interest rates ,
- project duration
...

IRR Sensitivity analyses (deviation in %)



Financing: Debt service, CFADS & DSCR



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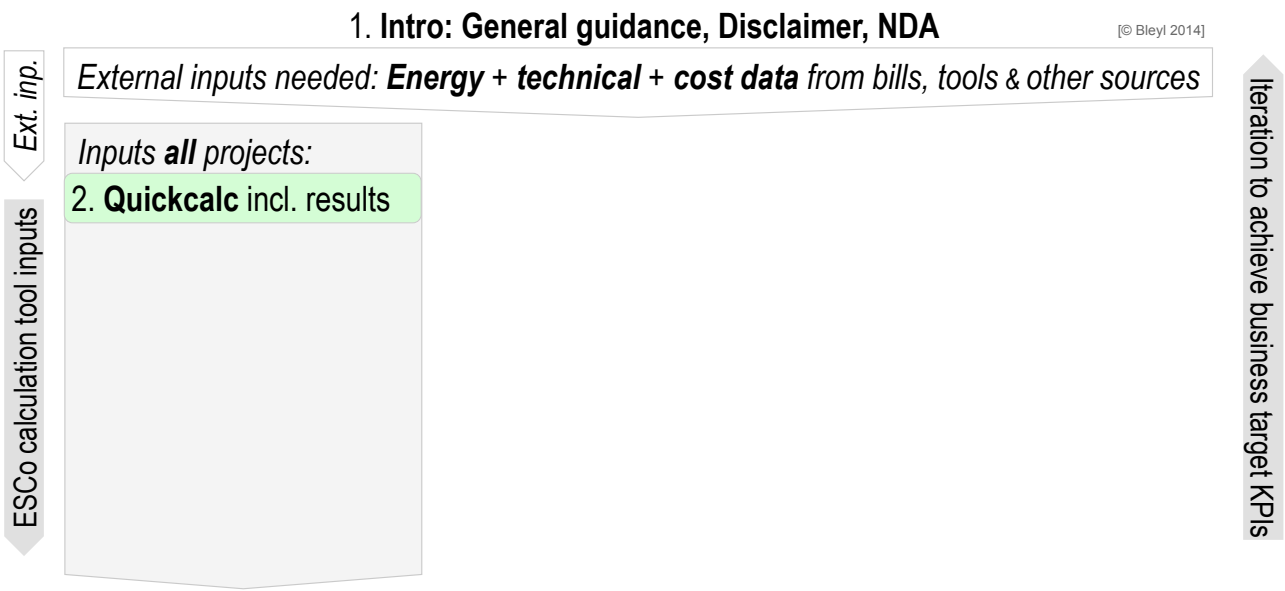
"Quickcalc" Sheet 2.:
Input- and Outputdata summary for simplified EE/EPC and RE/ESC projects

Investment / ESCo Calculation Tool:
Quickcalc: sheet 2.



Colours refer to Excel sheets in investment calculation tool

ESCo calculation tool spreadsheet:
2. Quickcals and summary

Goal and functionalities:

1. **Collection and preparation of input data for project calculation**

Remarks:

- ✓ **Input data summary** for all input data sheets of tool.
  Limited to one client, 1 EPC measure ….
  For additional clients => copy new lines into spread sheet
- ✓ *Excel sheets 1.-4 must be kept together to maintain translation functionality*

Input data for EE/EPC projects (minimum)
Sheet 2.: **Name, term, baseline, savings**

Investment-grade Calculation, Analyses & Financing of Energy Efficiency and Renewable Projects
Summary of Main Input Data

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project name and term

		year	month
project name	Master_150824		
project commencement		1	1
project termination		1	12
	corresponds to 1 years		

input for energy saving projects

baseline

customer (or area)	customer (or area)	
baseline sum	0	USD/a
baseline		MWh/a
average costs for energy		USD/MWh
power demand		kW
		USD/kW
misc. costs and fees		amount/a
		USD/amount
yearly price increase		%

savings

measures	sum of all measures	
sum of savings	0	USD/a
savings energy		%
	0	USD/a
savings power demand		%
	0	USD/a
savings misc. costs and fees		%
	0	USD/a
commencement of savings (main service phase)	1	year
	1	month
investor/ESCo savings share	100%	

input for energy supply projects

Input data for RE/ESC projects (minimum)
Sheet 2.: **Sales, hardware, energy cost**

heat sale

customer	customer	
revenues heat sale	0	USD/a
energy		MWh/a
		USD/MWh
power demand		kW
		USD/kW
yearly price increase		%/a

electricity sale

customer	customer	
revenues electricity sale	0	USD/a
energy		MWh/a
		USD/MWh
power demand		kW
		USD/kW
yearly price increase		%/a
electricity not sold to customers	0,0	MWh/a
feed-in tariff		USD/MWh

hardware

boiler		
thermal output		kW
annual efficiency (LHV)		%
CHP		
electric output		kW
electric annual efficiency (LHV)		%
thermal output		kW
thermal annual efficiency (LHV)		%
full load hours		h/a
PV or wind facility		
electric output		kWp
electricity generation / (kWp*a)		kWh/kWp
solar thermal facility		
absorbent surface		m²
system yield		kWh/(m² a)
all		
internal electricity demand (sum)		MWh/a

energy purchasing

fuel for boiler and CHP		
energy price		USD/MWh
capacity charge		EUR/kW
conversion factor HHV/LHV	1,00	-
yearly price increase		%
electricity		
energy price		USD/MWh
capacity charge		EUR/kW
yearly price increase		%/a

Input data for all projects (minimum)
Sheet 2.: **Project cycle cost** (CAPEX+OPEX)

costs (all projects)

CAPEX

	USD
total costs	**0**
hardware 1	
hardware 2	
hardware 3	
planning	
installation	
commissioning	
consulting services	
misc. costs	
subsidies + construction cost grant	

OPEX

	USD/a	yearly price increase
total costs	**0**	
management costs		
maintenance + repair		0,0%
insurance policies		0,0%
misc.		0,0%

Other cost and revenues during project term

	project year	1	following years	last year
misc. costs (-) and revenues (+)	USD/a			

Input data for all projects (minimum)
Sheet 2.: **Financing**

Financing : debt and equity capital

debt capital		financing share	annual interest rate	disagio	effective interest rate	principal payments per year
loan I	0			0,00%	0,00%	4
loan II	0	0,0%	0,0%	0,00%	0,00%	4
loan III	0	0,0%	0,0%	0,00%	0,00%	4
loan IV	0	0,0%	0,0%	0,00%	0,00%	4
annuity loan	0	0,0%	0,0%	0,00%	0,00%	4
loan sum	**0**	**0,0%**				
equity capital	**0**	-		calculatory interest rate		

	date of borrowing		first principal payment		last repayment	
debt capital	year	month	year	month	year	month
loan I	1	1	1	3	1	12
loan II	1	1	1	3	1	12
loan III	1	1	1	3	1	12
loan IV	1	1	1	3	1	12
annuity loan	1	1	1	3	1	12

Day 3

Investment-grade Calculation, Analysis & Financing of Energy Projects *(Focus on Energy Performance Contracting)*

Introduction & Hands-on Training

Jan W. Bleyl, Energetic Solutions & IEA DSM Task 16
Simon Zellner, GIZ
Bangkok, Thailand, January 2016

Calculation Training_Thailand
Agenda_day 2 20/01/16_Summary

When	Topic	Who
09:00	Summary of calculation tool and Q&A from previous day *3. Group work:* Calculation of own EE projects *(or other examples)*	Bleyl Participants
10:30	*Break*	
10:45	*3. Group work (cont'd)* => Presentation & discussion of results, incl. KPIs, CFADS, financial engineering, parameter sensitivity ... Q/A	Participants + Zellner & Bleyl
12:00	*Lunch*	
13:00	Manual and automatic sensitivity analyses with calc.-tool	Bleyl
13:45	„Quickcalc": Intro and PV example	Bleyl *or* Zellner
14:30	*Break*	
14:45	Deepening of selected training topics based on participants project calculation examples	Participants + Bleyl + Zellner
16:00	*End of day 2 (agenda adjustments possible, subject to training needs)*	

Calculation Training_Thailand
Agenda day 3_Thursday 21 Jan. '16

When	*Topic*	*Who*
09:00	Summary and Q&A from previous day *4. Group work:* Project risks: Identification and mitigation	Bleyl Participants
10:30	*Break*	
10:45	ESCo calculation tool as management instrument for projects: Reporting, risk- + sensitivity analyses, price development ...	Bleyl Participants
11:30	Wrap up: Q/A, your next steps towards investment projects? Feed back on the training	Bleyl + Zellner + Participants
12:00	*Lunch*	
13:00	Financing of ESCo/EE/RES projects from a bank's perspective: Strategy, procedures, approval criteria … Q & A	Kasikorn Bank
13.30	ESCO Fund: Strategy, procedures and approval criteria	ECFT
14:00	Revolving Fund: Strategy, procedures and approval criteria	DEDE
14.30	*Break*	
14:45	Certificate ceremony and final remark	Dr. Beerepoot
15:30	*End of training (agenda adjustments possible, subject to training needs)*	

Group work or discussion: Identify and discuss your project implementation risks?

1. What are the **risks of your Investment/ESCo-projects**?
2. What are the specific risks of **EE/EPC** or **RE/ESC**-projects?
3. **Who can bear/manage/mitigate** these risks best?
4. What is your **risk mitigation strategy**?
5. Where can the **calculation tool be of support?**

This is very important for preparing discussions with:

- ✓ Your **management** and **stakeholders**
- ✓ Your **financier**

*PS: **Sales argument towards your customer:** An **ESCo will bear economical and technical project risks**!*

Project implementation risks and mitigation
Technical_Thailand_16/01

Risk	Risk bearer	Risk mitigation

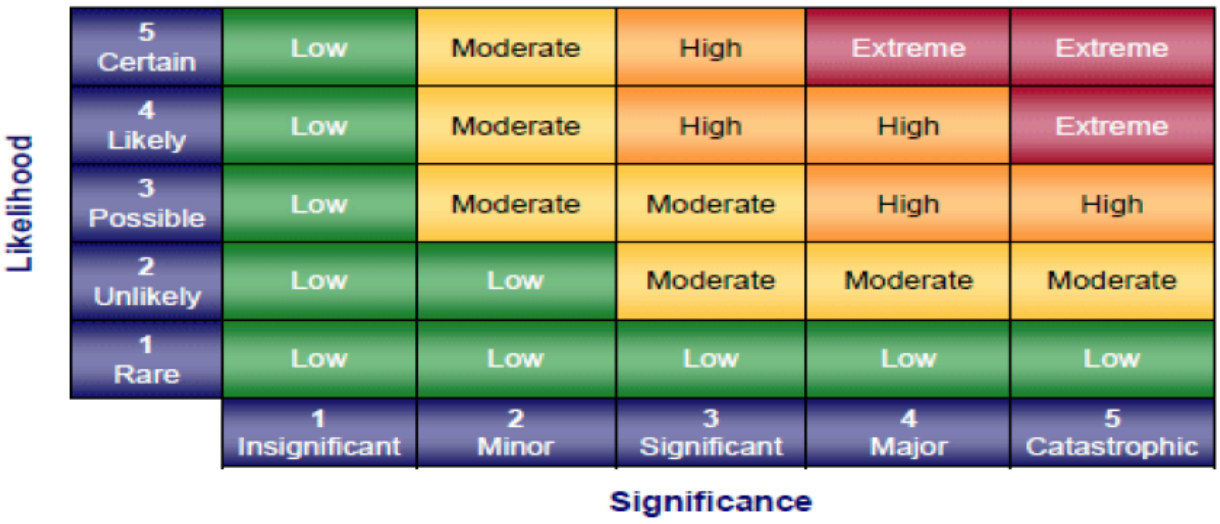
Project implementation risks and mitigation
Economical/financial_Thailand_16/01

Risk	Risk bearer	Risk mitigation

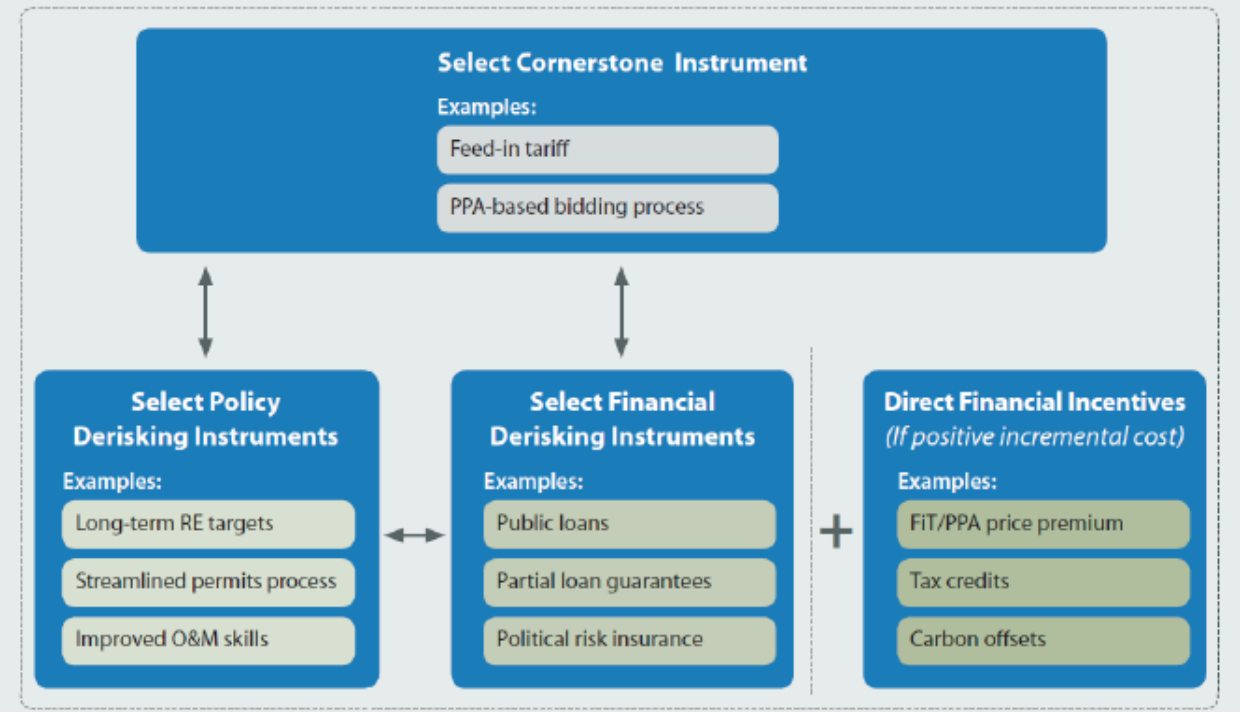
Project implementation risks and mitigation
Policy/Legal/framework_Thailand_16/01

Risk	Risk bearer	Risk mitigation

Risk prioritization map – ISO 31000:2009

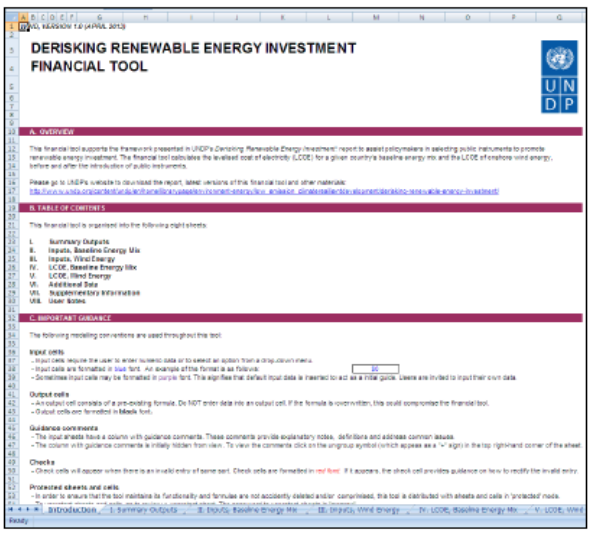


Selecting a package of public instruments (UNDP)



Source: UNDP, Derisking Renewable Energy Investment (2013).

Reports & Financial Tool



Source: UNDP, Derisking Renewable Energy Investment (2013).

Available at www.undp.org/DREI

Bankable Project Calculation Tool as a Management Instrument (Summary)

Investment calculations are projections into an (uncertain) future ...

1. EE and RE projects (like infrastructure) are typically **capital intensive, long-term investments** (across a number of accounting periods)
   => we need **dynamic, investment-grade analyses methods** and **decision instruments**
2. **Prospective economics calculation** (e.g. capital budgeting) is a **prognoses, a projection into a** (more or less unknown, uncertain) **future**
3. => be aware of **opportunities** but even more so of **uncertainties** and **risks.**
   => profound **risk management needed**

=> *Discussion:* ***Where can calculation tool help?***

Investment calculation as a project development and management tool (1/2)

1. Detailed project calculation (+ controlling) is an important **tool for economic and technical project management and risk asessment, => e.g. sensitive parameters and anaylses**

2. **Decision support for entire project cycle**, e.g.:
   - ✓ *Pre-feasibility:* Key parameters to focus on?
   - ✓ *Detailed planning/design:* Which technical solutions to implement (e.g. CHP or not)?
   - ✓ *Proposal:* Calculation of bid to client
   - ✓ *Financing:* Effects of equity and debt financing shares?
   - ✓ *Operation phase*: Which parameters to monitor?
   - ✓ ...

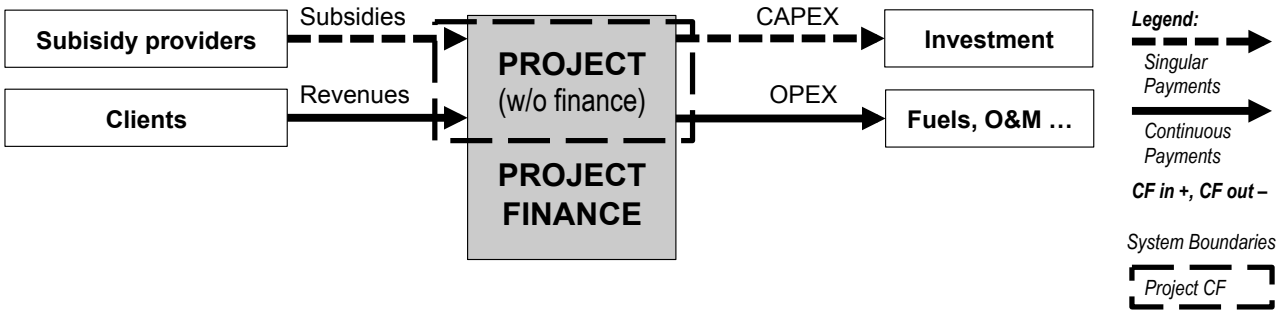
Investment calculation as a project development and management tool (2/2)

3. Cash flow + profit & loss calculations as a bases for **project reporting** and **decision making** (e.g. to management boards, project stakeholders)

4. Cash flow analyses for **convincing, negotiations & due diligence with Financiers** (FI)

5. Support **policy design**, e.g. subsidy or funding demand calculations (amount and timing)

Project, debt and equity cash flows (CF), their **relationships** and **balance equations**

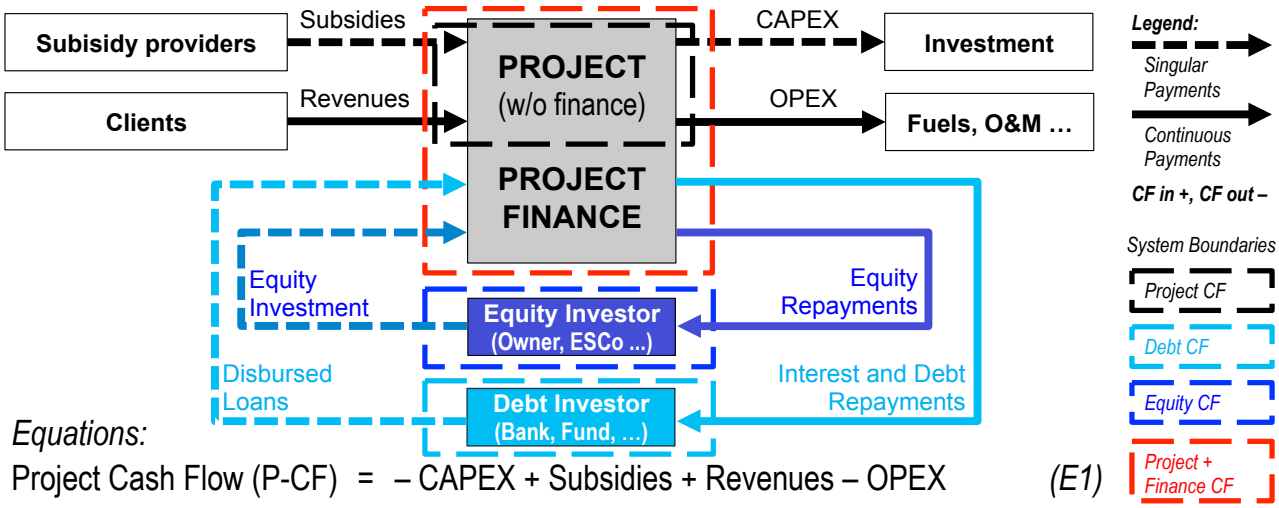


Equations:

Project Cash Flow (P-CF) = – CAPEX + Subsidies + Revenues – OPEX *(E1)*

Equations are either cummulative Σ_i over project term or annual

Project, debt and equity cash flows (CF), their **relationships** and **balance equations**



Equations:

Project Cash Flow (P-CF) = – CAPEX + Subsidies + Revenues – OPEX *(E1)*

Debt Cash Flow (D-CF) = – Disbursed Loans + Interest + Debt Repayments *(E2)*

Equity Cash Flow (E-CF) = – Equity Investment + Equity Repayment *(E3)*

Project = Finance CFs! **P-CF = D-CF + E-CF** => *(E1) = (E2) + (E3)* ⇔ *(E4)*

E-CF = P-CF – D-CF = – CAPEX + Subsidies + Disbursed Loans + Revenues – OPEX – Interest – Debt Repayments

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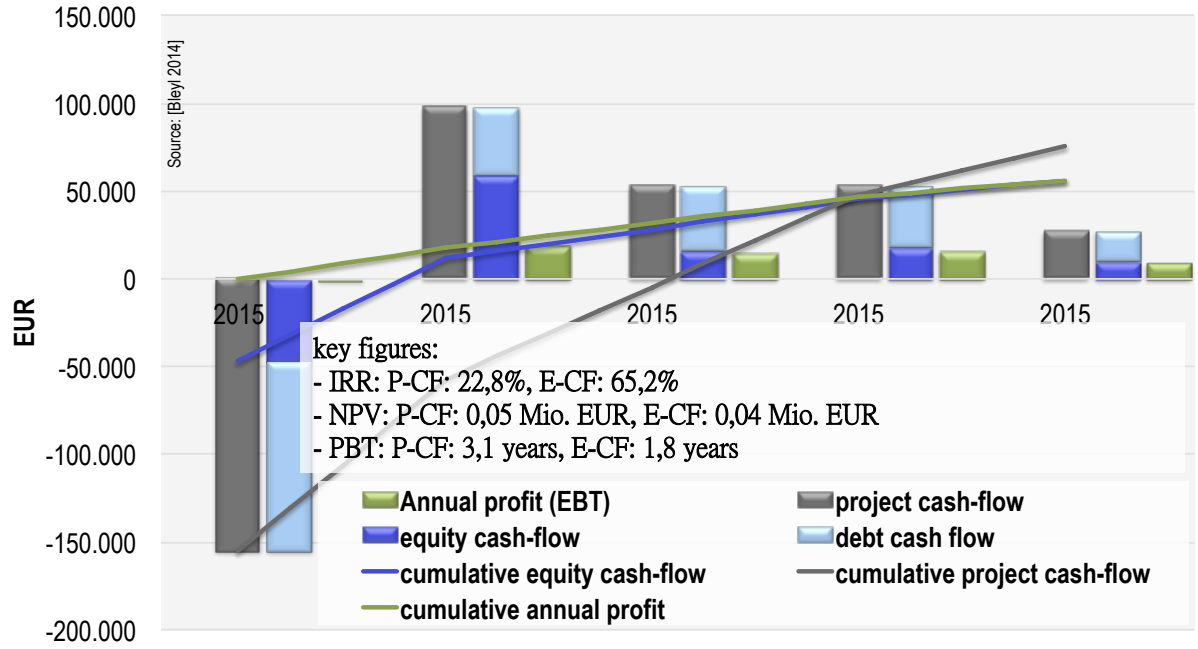
Equations are either cummulative Σ_i over project term or annual

Project, Equity, Debt Cash Flows & Profits (EBT) (annual + accumulated)



Sensitivity Analysis

Economics calculations are predictions into a (partially unknown) future. They are based on assumptions about the future development of revenues and expenses.

The real prices and cost may diverge and therefore may result in different profitability projections.

Typical parameters with high sensibility are:

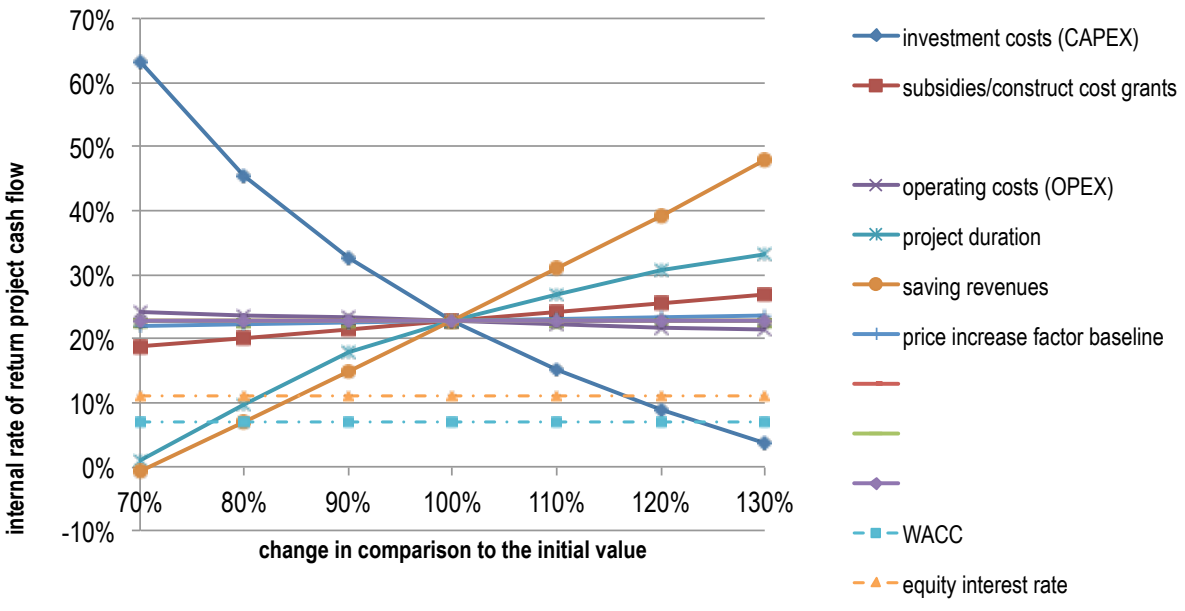
EPC: **Amount of savings, investment cost, interest rates** …

ESC: **Fuel cost**, **annual efficiency** of boiler, CHP, solar …

=> Sensitivity analysis with key parameters recommended

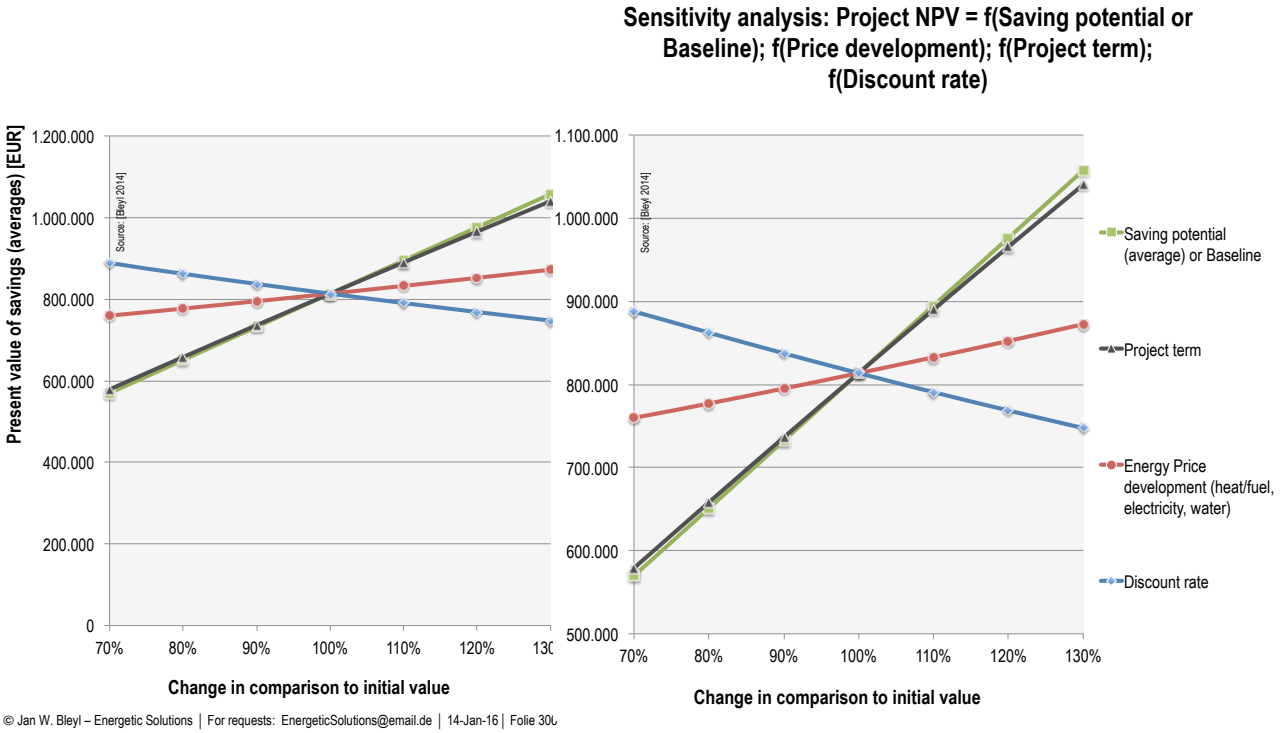
Threshold or break-even analyses, target-value-search, sensitivity analyses e.g. for:
- energy cost savings,
- price developments,
- investment costs,
- time of payment of subsidies,
- interest rates ,
- project duration
...

IRR Sensitivity analyses (deviation in %)

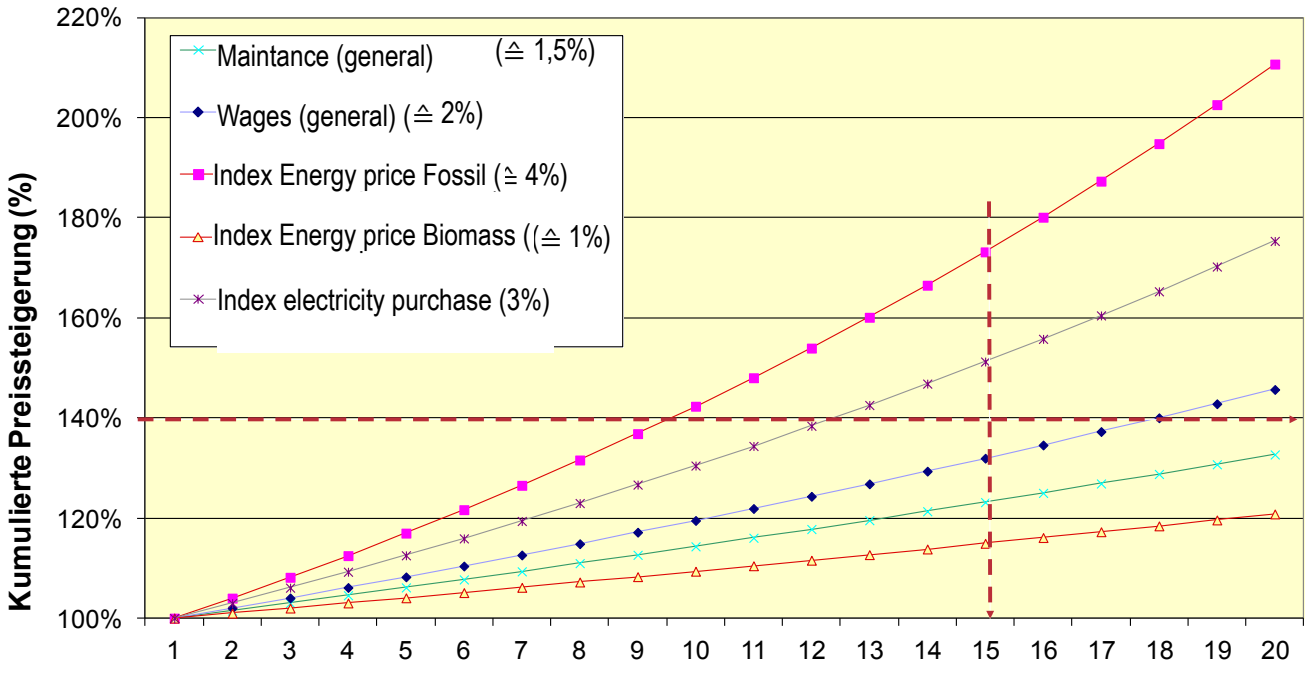


Sensitivity analyses

Beware of „visual distortion“



Sensitivity of different rates of price increases



Questions & answers

ESCo Calculation Tool: **Summary and questions**

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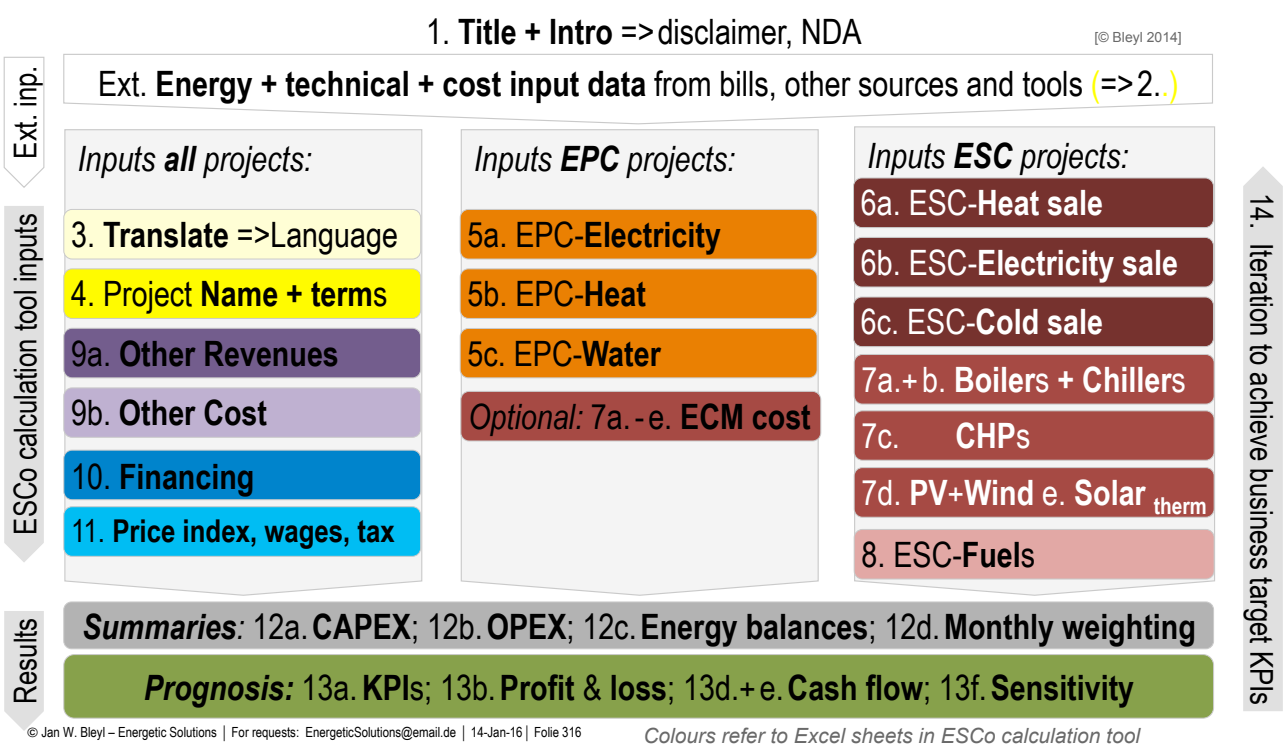

Colours refer to Excel sheets in ESCo calculation tool

Training goals achieved?

1. Introduction to **Project** / **Life Cycle Cost concept** and to basics of **dynamic economics calculation**
2. Familiarize you with **economic**, **financial** & **banking language**
3. Detailed introduction to a **comprehensive investment-grade calculation tool** for EE and RES projects
4. Enable you to **calculate** your own **savings projects**
5. Discuss **results, KPIs, risks, sensitivity analyses, reporting**

⇒ **"Awareness through Cash Flows"**

⇒ **Facilitate cooperation with financial institutions, technical due dilligence and project management**

⇒ **Support EE, RES & ESCo market development**

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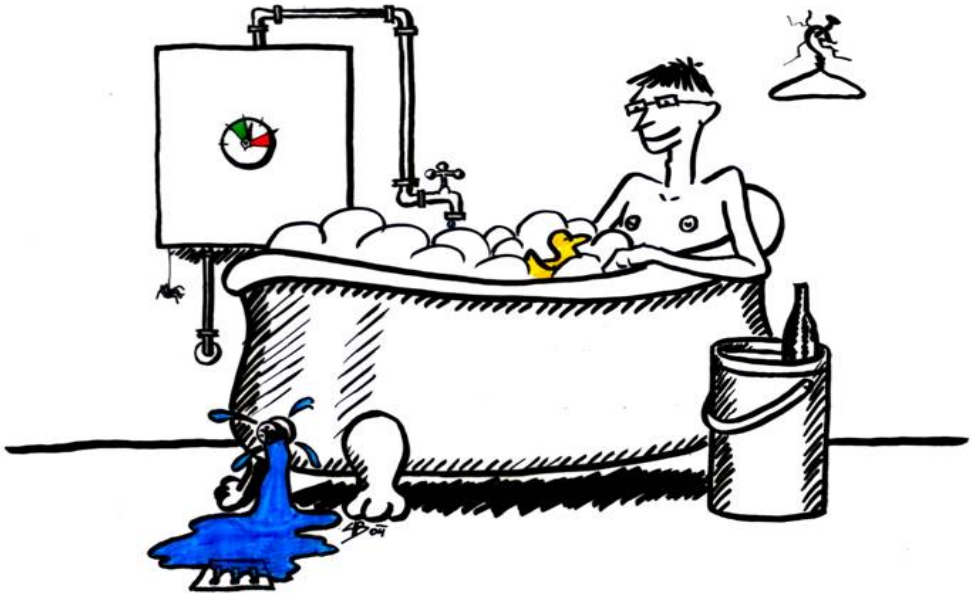
Coaching for projects?
Additions to the Excel tool needed?
…?

Your next steps back home in your office?

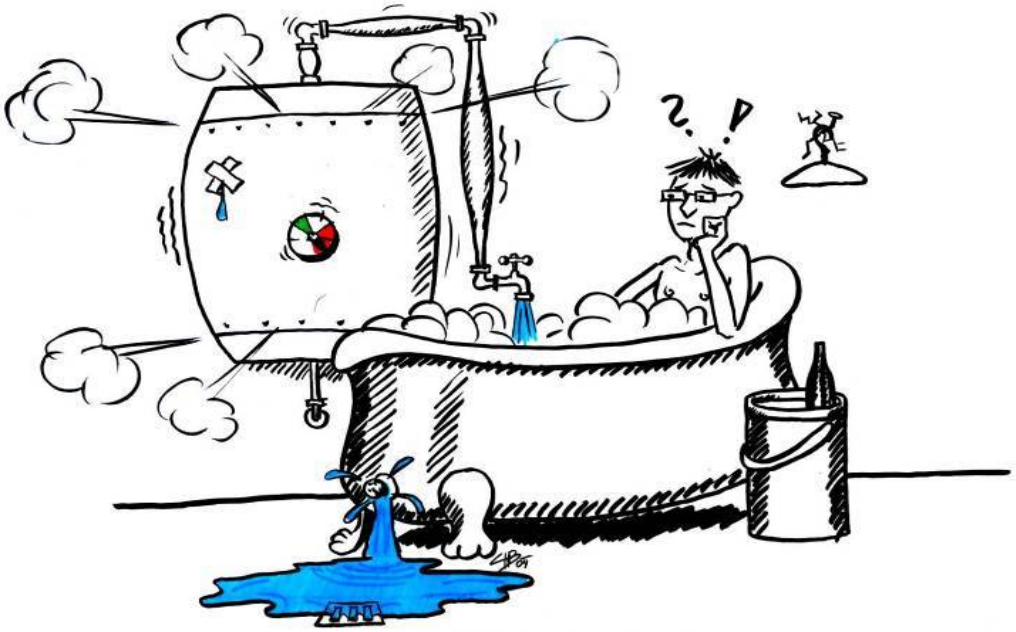
Feed back on the 3 day training

Awareness raising



Support in Search for Solutions?

Efficiency before supply!



Win – Win - Win

Thank You very much!
Thank you whoever helped to organize!

Good luck with your projects!

Jan W. Bleyl, Energetic Solutions & IEA DSM Task 16
Simon Zellner, GIZ
Bangkok, Thailand, January 2016