Annex 61: Deep Energy Retrofit of Public Buildings

Economic Feasibility of ‚Deep Retrofit': A Financial Approach to Project Assessment and Development. Economic Model and Case Study

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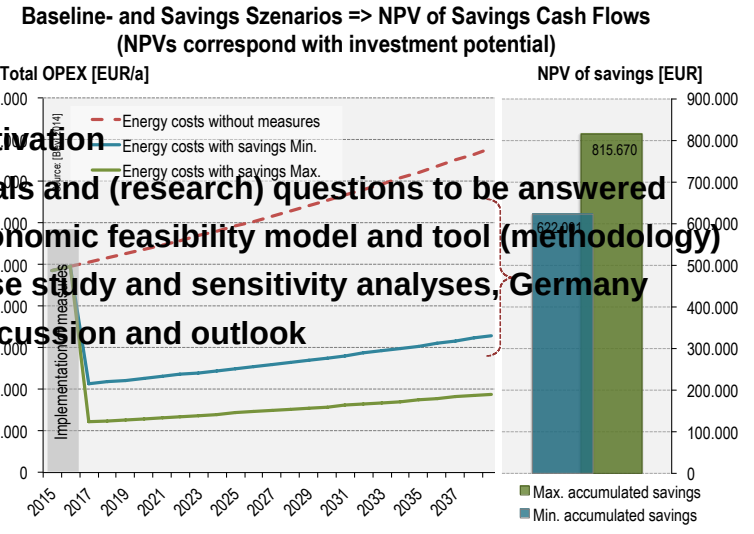
Technical day Tallin, Estonia, September 22nd 2014

Outline



1. Motivation
2. Goals and (research) questions to be answered
3. Economic feasibility model and tool (methodology)
4. Case study and sensitivity analyses, Germany
5. Discussion and outlook

Initial situation and motivation

1. **Technical studies** take time and ressources, data availability is a pain ... (which are often unpaid)
   but often still **fail to reach decision makers**
2. **Decision makers** are typically non-engineers
   => they want to talk **cash flows** and **risks**.
   And they may not even be interested in your great technical solution.
3. **We** need to talk cash flows and KPIs and present results in an easy and quick to understand way

=> Develop a tool for **financial project assessment** based on easily available data => **feasibility check**
For presentation to **financial decision makers**

Economic feasibility model and tool: **Goals and questions to be answered**

1. Build **cash flow scenarios and KPIs** with **easily accessibly input data** to communicate with **building owners/decision makers**
2. **Awareness raising** and **visualization for building owners:**
   - ⇨ How much do you currently pay for energy?
   - ⇨ And how might energy cost develop (scenario)?
   - ⇨ What if so much could be saved?
     And which investments could be re-financed from these savings?
   - ⇨ How much does it cost to wait?
3. **Estimation of financial saving potentials**
   - ⇨ How much money could be saved (min. - max.)?
   - ⇨ And how do NPVs of saving cash flows compare to investment needs?
4. **Easy to communicate with decision makers:**
   => Cash flows and **KPIs; no technicalities; figures, little text**

Economic feasibility model and tool: **Input data, outputs and methodology**

1. **Input data** (either first estimates, benchmarks *or* from detailed analyses)**:**
   - ⇨ Current **OPEX**: energy, water, o&m, others (e.g. CO_2, productivity loss)
   - ⇨ **Annual price development factors** for each cost category
   - ⇨ **Saving potentials** per cost category: Minimum and maximum values (to model and account for insecurities about exact data)
   - ⇨ **Project term** and **discount factor**
   - ⇨ *Optional:* **Investment cost** of interventions („Delta cost“)

Economic feasibility model and tool: **Input data, outputs and methodology**

2. **Outputs:** Scenarios and KPIs
   - ⇨ **OPEX development** scenario without interventions
     => individual and cumulative **baselines**
   - ⇨ **Saving cash flow** scenarios
     => individual + cumulative **saving potentials** (Min. – max.)
   - ⇨ **NPV of future savings cash flows** => comparison with investments
   - ⇨ **Sensitivity analyses** (single + multiple parameters)
   - ⇨ **Opportunity cost**: How much does it cost to wait?
3. **Iteration based on more detailed analyses and data** (if needed)

Economic feasibility assessment, case study
IWU building, Darmstadt

(based on data inputs from KEA, Germany)

IWU, Darmstadt, Germany: 1.680 m²; Energy cost Baseline: 50 kEUR/a; 23 years

Retrofit variants:

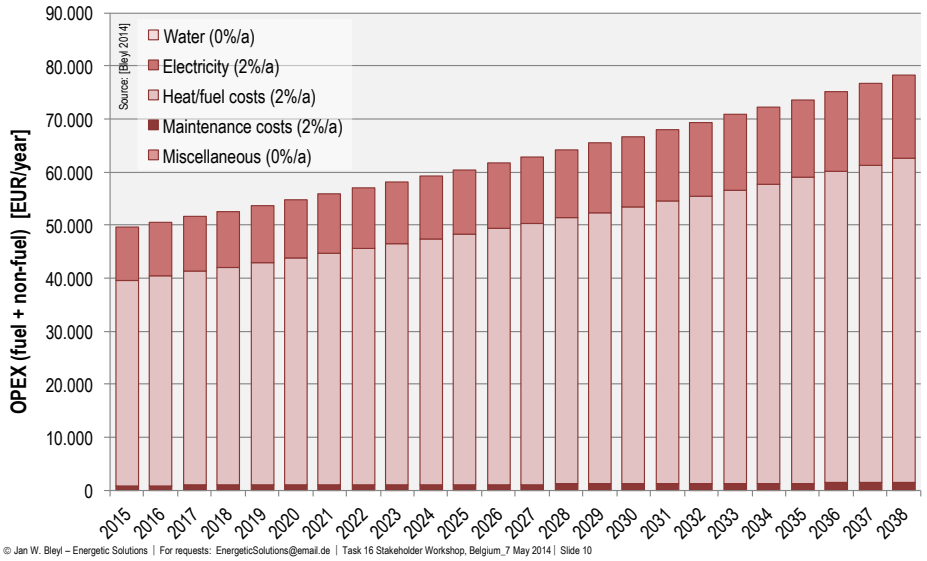
- ⇨ **Cost optimized PH; -85%; Invest: 975** kEUR (Sc 3)
- ⇨ **EnEV 2014 new buildings; -68%; Invest: 839** kEUR (Sc 2)
- ⇨ **Alexander Special; -59%; Invest: 727** kEUR (Sc 7)

Economic feasibility assessment, case 1

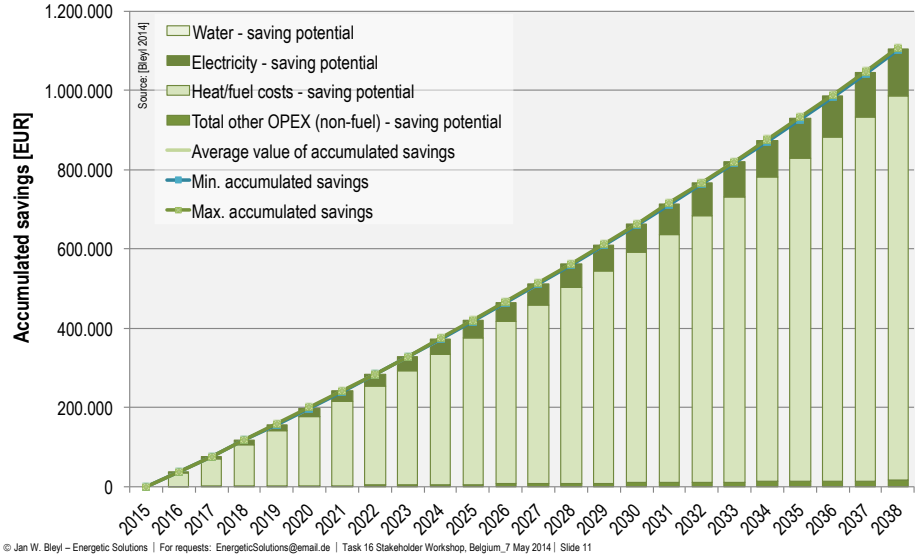
IWU building, Darmstadt: Cost optimized PH refurbishment Sc 3

(based on data inputs from KEA, Germany)

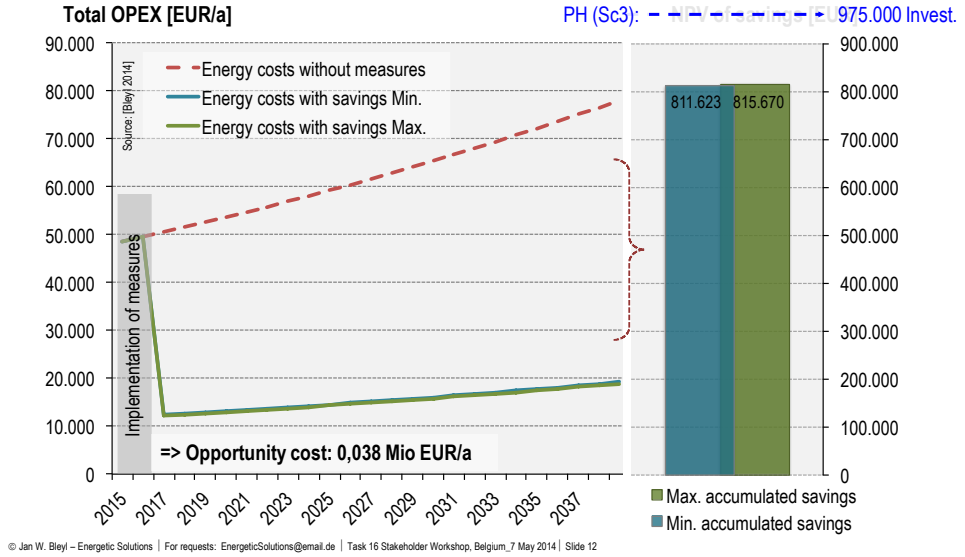
IWU: Cost optimized PH refurbishment Sc 3
Cost development w/o **measures** = **Baseline**



IWU: Cost optimized PH refurbishment Sc 3
Accumulated saving potentials

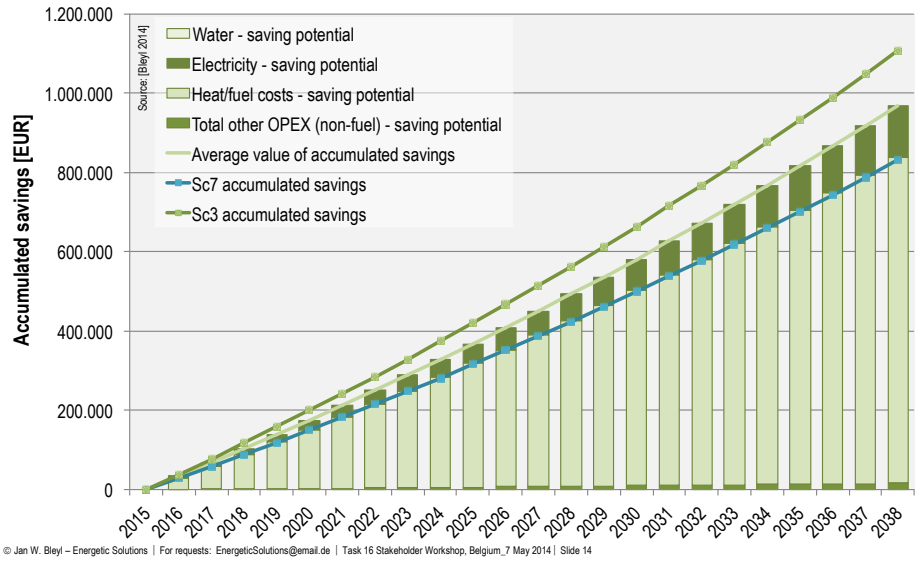


IWU: Cost optimized PH refurbishment Sc 3
Baseline, savings scenario □ NPV of Savings-CF

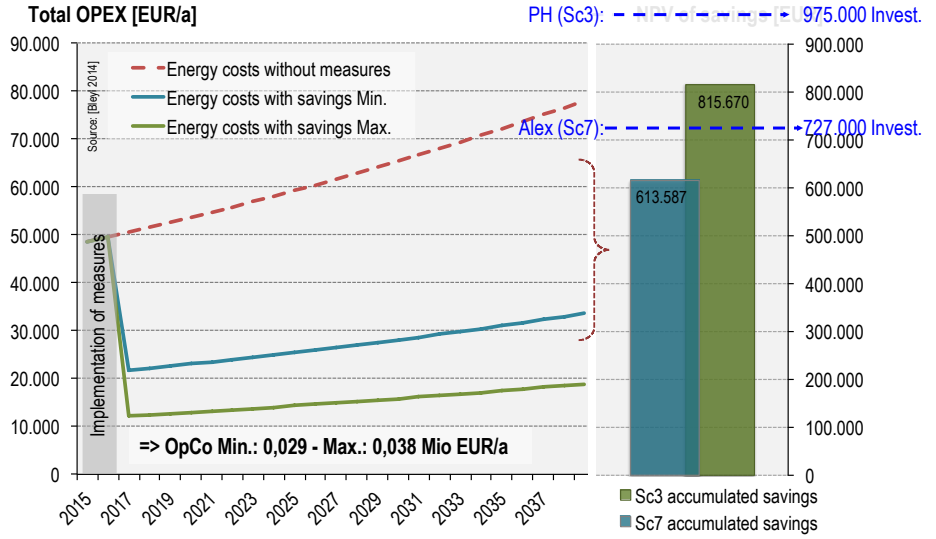


Economic feasibility assessment, case 2
IWU building, Darmstadt:
"Cost optimized PH refurbishment Sc 3"
vs.
"Alexander Special - 59% Sc 7"
(based on data inputs from KEA, Germany)

IWU: Alexander (Sc7) vs. PH (Sc 3)
Accumulated saving potentials



IWU: Alexander (Sc7) vs. PH (Sc 3)
Baseline, savings scenario NPV of Savings-CF



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Economic feasibility assessment, case 2 – "manual" sensitivity analyses

IWU building, Darmstadt:

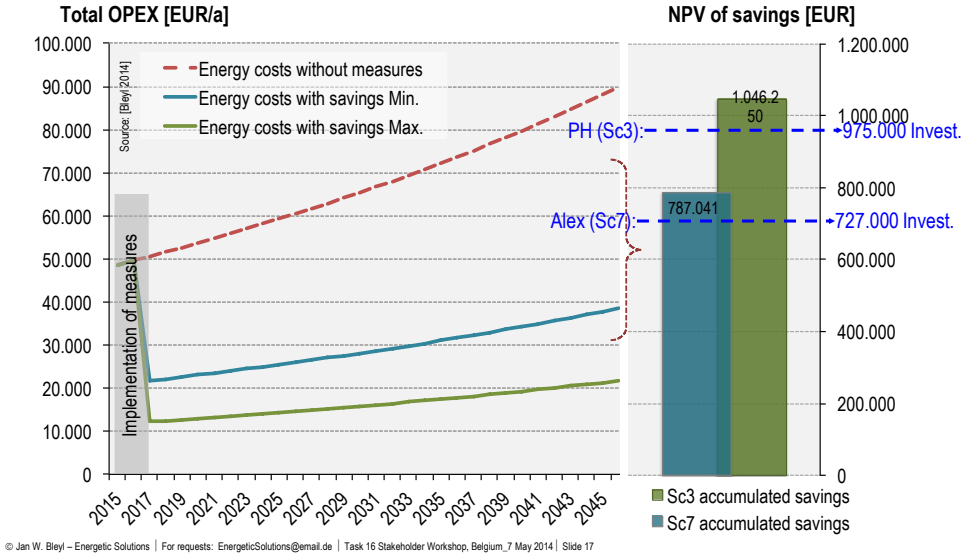
"Cost optimized PH refurbishment Sc 3"

vs.

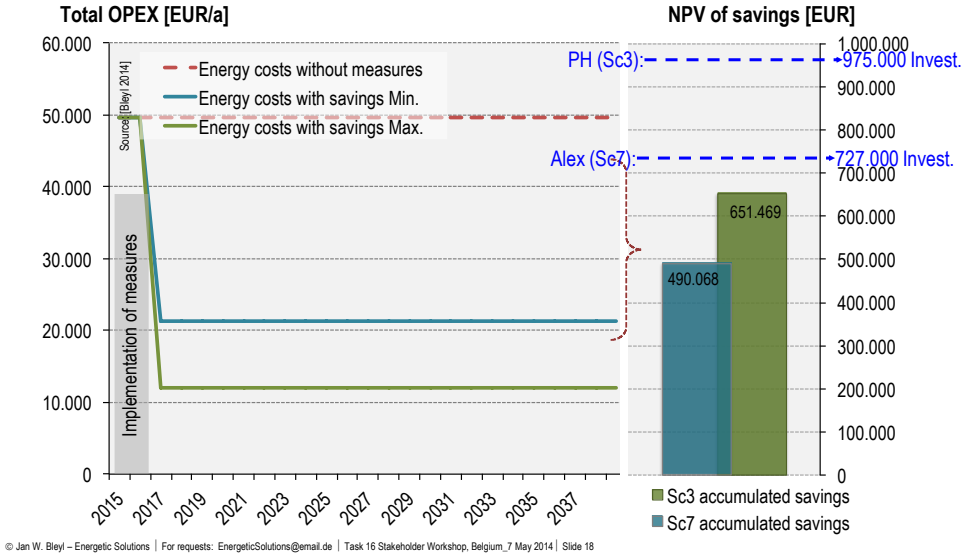
"Alexander Special - 59% Sc 7"

(based on data inputs from KEA, Germany)

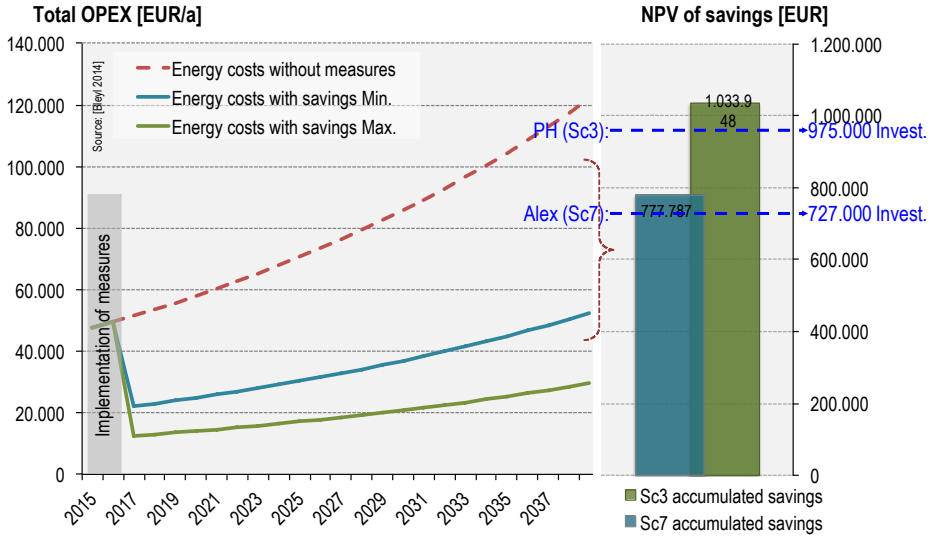
IWU: Alexander (Sc7) vs. PH (Sc 3)
Sensitivity analyses: **30 years** (Ref.: 23 y)



IWU: Alexander (Sc7) vs. PH (Sc 3)
Sensi: **Price development: 0%/a** (Ref.: 2%/a)



IWU: Alexander (Sc7) vs. PH (Sc 3)
Sensi: **Price development: 4%/a** (Ref.: 2%/a)



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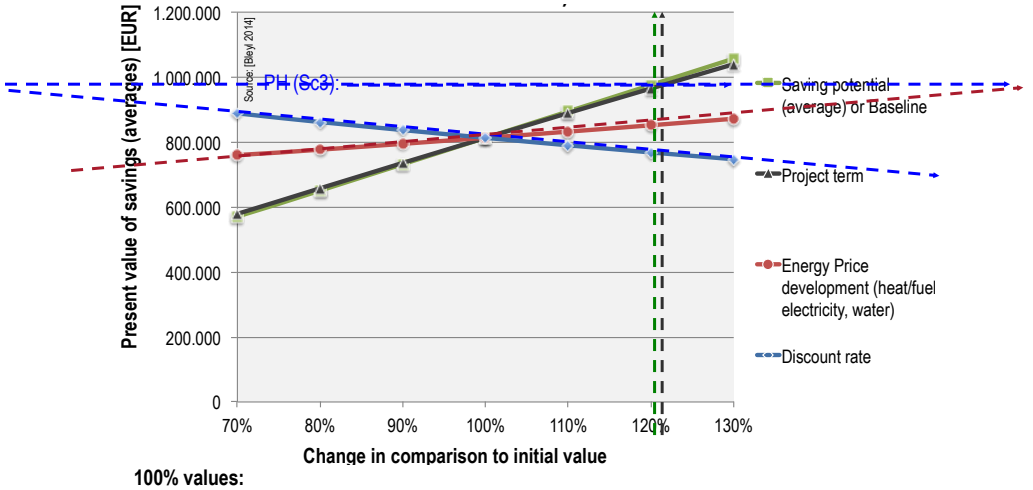
Economic feasibility assessment, case 1 – " "automatic" sensitivity analyses
IWU building, Darmstadt: Cost optimized PH refurbishment Sc 3 (based on data inputs from KEA, Germany)

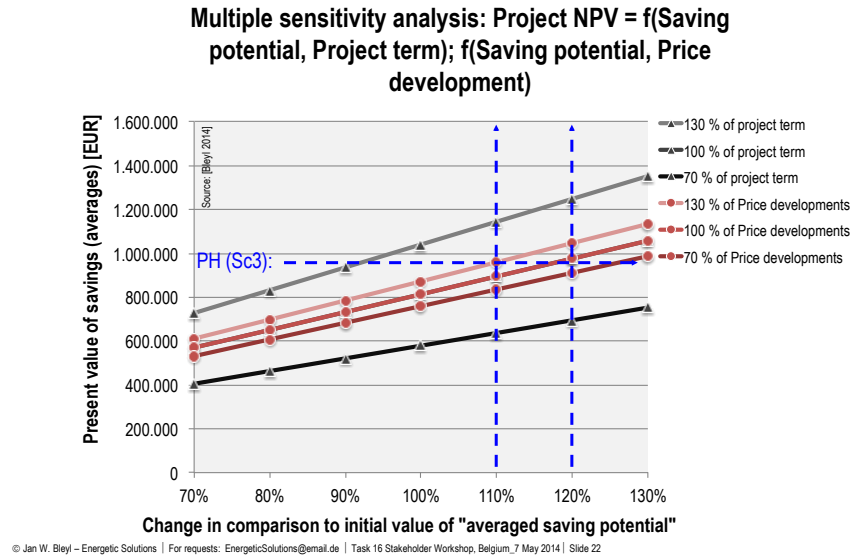
IWU: Cost optimized PH refurbishment Sc 3
Single parameter sensitivity analyses



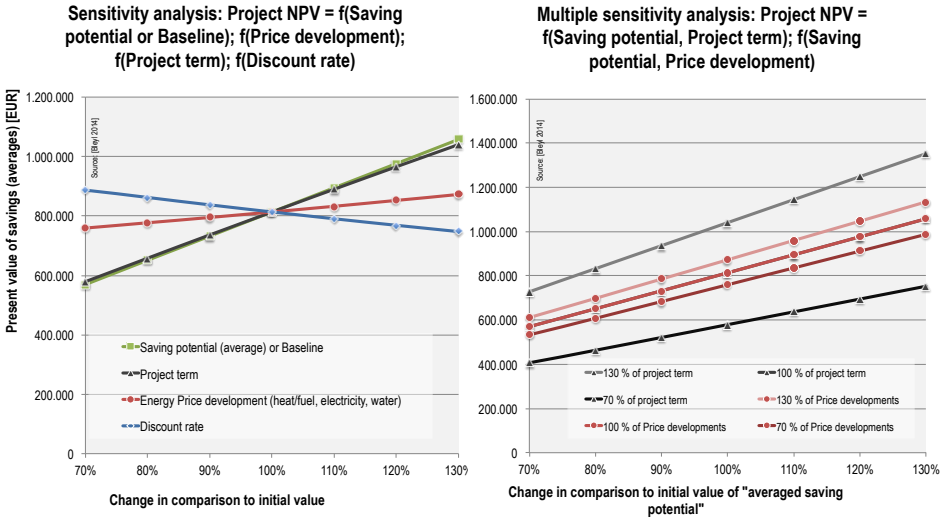
100% values:

Baseline (average)	savings (average)	Project term	price development	Discount rate
62.274 EUR/a	**45.965** EUR/a	**23** years	**2%**	**2,5%**

IWU: Cost optimized PH refurbishment Sc 3
Multiple paramenter sensitivity analyses



IWU: Cost optimized PH refurbishment Sc 3
Single + Multiple paramenter sensitivity



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Discussion

1. **Few** data inputs needed for feasibility analyses. Can be estimates, benchmarks or from detailed assessments
2. Which of **your questions** are answered by the feasibility model? **What is still missing** in your views?
3. **Financial** (vs. technical) **approach**:
   Suitable to inform and convince building owners?
4. **Opportunitiy cost**: It costs to wait
5. New ESPC paradigm: **ESCo models for co-financing**
   (not necessarily 100%) + ??? …
6. … we need additional financing sources for deep retrofit, e.g. **Non-Energy-Benefits:** e.g. comfort or productivity increase (c.f. **www.comfortmeter.eu/** Johan Coolen) *or* mitigation of future price increases, client relationships, CSR … (c.f. IEA publication)

Outlook

1. **Economic feasibility**: **=> Your projects** (up to 10)
   => contact me to receive template for data input
2. Deep retrofit **business models**
   => please check Task 16 publication (c.f. separate slide) and provide feedback
3. **Non-energy-benefit** (NEB) for co-financing
   => ideas, literature …
4. **Investment grade calculation and financing**:
   => Your projects (up to 3)

Task 16 paper on ‚Comprehensive Refurbishment of Buildings with Energy Services‘

Bleyl, Jan W.; Schinnerl, Daniel
Comprehensive Refurbishment of Buildings with Energy Services
in ECEEE Summer Studies,
paper ID 5,039, France June 2009

Jan W. Bleyl-Androschin, Daniel Schinnerl: Paper ID# 5,039

Comprehensive Refurbishment of Buildings with Energy Services

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Keywords
Comprehensive Refurbishment of Buildings, Energy Services, Contracting, Demand Side Management, ESCo, Energy Efficiency Measures, EE+ES Directive

Abstract

Energy Performance Contracting (EPC) Projects, if implemented properly, have successfully delivered guaranteed savings since they were first established in Europe about 1995[1]. Consequently the new **EU Directive on Energy End-use Efficiency and Energy Services**[2] supports EPC and views it as an important instrument to implement energy efficiency based on market instruments.

EPC-projects realize demand reduction measures which typically encompass building technologies like HVAC, electrical applications and control systems. In most cases, building envelope refurbishment measures are excluded. As a consequence, large saving potentials are neglected in the refurbishment process and they are lost until the next comprehensive refurbishment cycle of the building some 30 years later. **Obstacles** like no integrated planning approach, too long pay back periods of the energy efficiency investment measures, procurement problems or a lack of knowledge on implementation models and various others are some of the reasons behind.

In this paper, we propose and describe **models how to integrate building refurbishment measures into EPC-models**, in order to achieve a comprehensive refurbishment (CR) of buildings as indicated above (**CR-EPC-projects**: a "**General Contractor**" (GC), a "**General Planner**" (GP) and a "**CR-Light**"-**EPC-model**. The decision for an implementation model can be taken after completion of preliminary project planning.

Factors for applicability of the models (especially for the public sector) are described out of which the most important ones are 1. share in building construction measures from project total, 2. whether functional or detailed specifications for the awarding of the CR-works and services are applied and 3. who the building owner wants to put in charge of detailed planning, overall optimization and supervision of the project: a GC or a GP?

Comprehensive Refurbishment-EP-Model selection flow chart

To sum up, the paper gives **conclusions and recommendations** for the implementation of CR-projects and a short **outlook** on future activities and research.

in co-operation with: ieadsm energy efficiency

Task 16
"Competitive Energy Services"
www.ieadsm.org

EBC
Energy in Buildings and Communities Programme

Thank you!

Questions and remarks welcome!

Get in touch:

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