Annex 61 Business and Technical Concepts for Deep Energy Retrofits of Public Buildings

Advanced Business and Financial Models for Deep Energy Retrofit (DER) Guideline

Rüdiger Lohse, co- operating agent Annex 61

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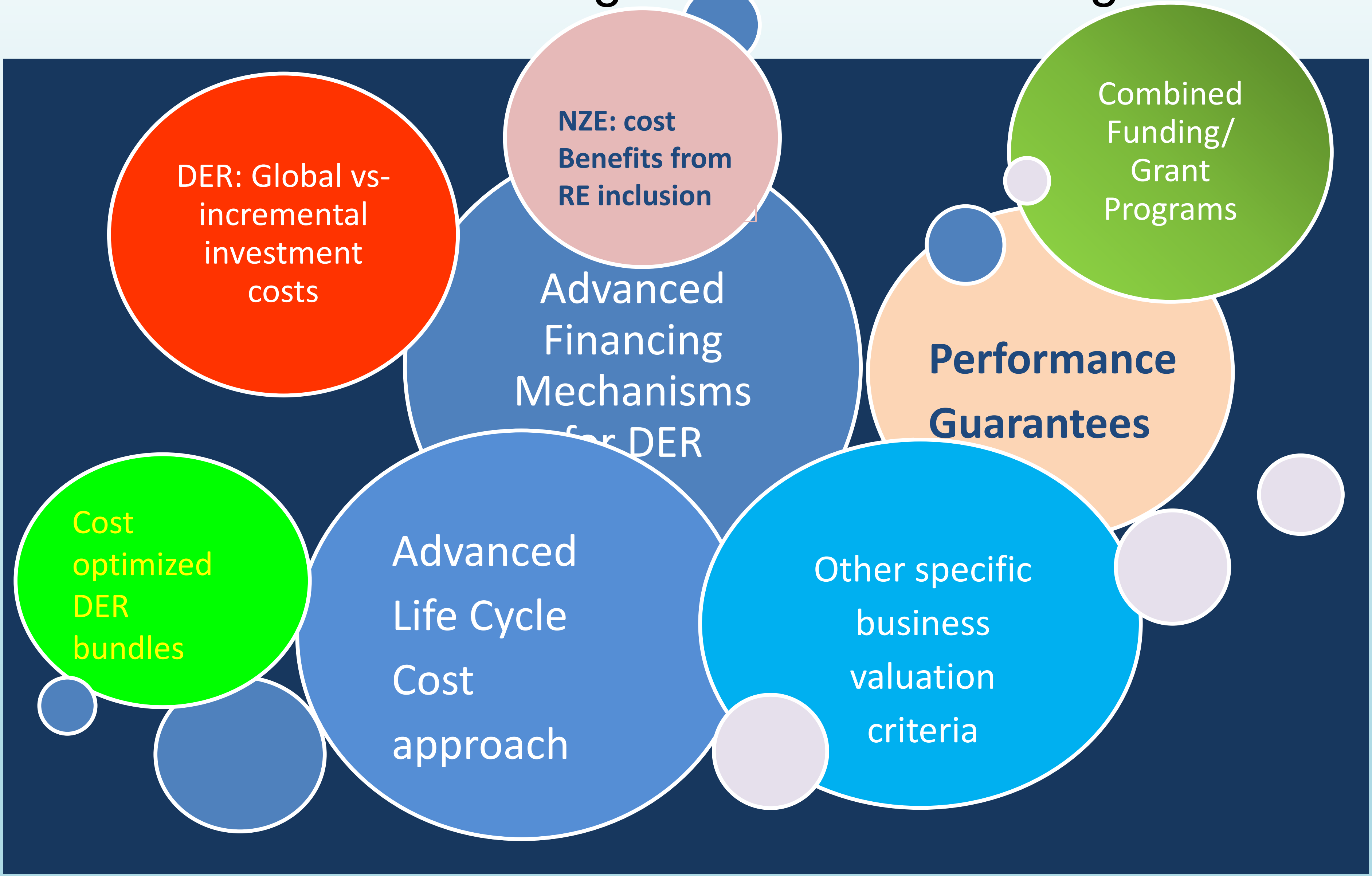
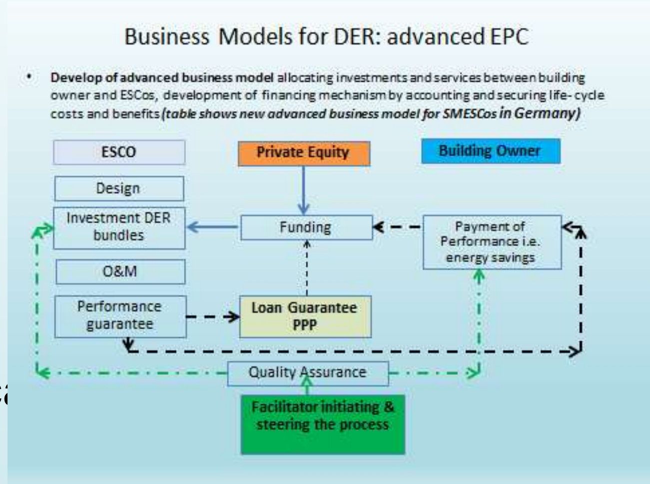
Advanced Financing Mechanisms driving DER



The DER Business Model Guide



- Which are the most prevalent barriers ?
  - Market, legal
- Existing Financial and Business Models
  - How are we implementing DER and EE project today?
  - How are liabilities, risks, revenues and investments alloca
- Economics of DER projects
  - Cash flow based economics of DER projects
  - Least cost planning path approaches to optimize investment costs
  - How to leverage non- energy related + bankable benefits
  - Design strategies to increase cost effectiveness of DER
- Funding of DER projects
  - Basic and advanced financing models
  - Off- and on balance- EPC going capex=opex pathway
  - Refunding of ESCOs- requirements to projects
- Advanced DER EPC

Draft available for review by November 2016

DER Investment Costs: global or incremental

Two scenarios to determine DER investment costs (this + next 2 slides)

A

Incremental investment costs for DER has to be considered: left column on the next slide:

- Scenario A: a major renovation is carried out to repurpose a building the energy minimum requirements have to be considered (white part of the column) and public funding is provided in a significant amount of seed funding, SRM funding etc.
- Additional DER investment cost can achieve any energetic quality in the building beyond the minimum requirements.
- The investment cost which has to be funded in addition is the DER investment cost

$$\textit{(a)} \quad \boldsymbol{Incremental\ Investment\ Costs = DER\ Investment\ global\ - Seed\ Money}$$

- The decision making is ***simple or dynamic pay back or NPV of advanced LCC***
- Next slides show at the hand of an office building that within s**imple pay back periods of 10- 12 years** the current energy targets for new buildings can be realized
- But: Scarcity of public money to provide the “seed money” has to be considered as a restrictive factor to get the DER process started; Many public bodies are not able to provide enough “seed funding” to set up a sufficient number of projects

DER Investment Costs: global or incremental

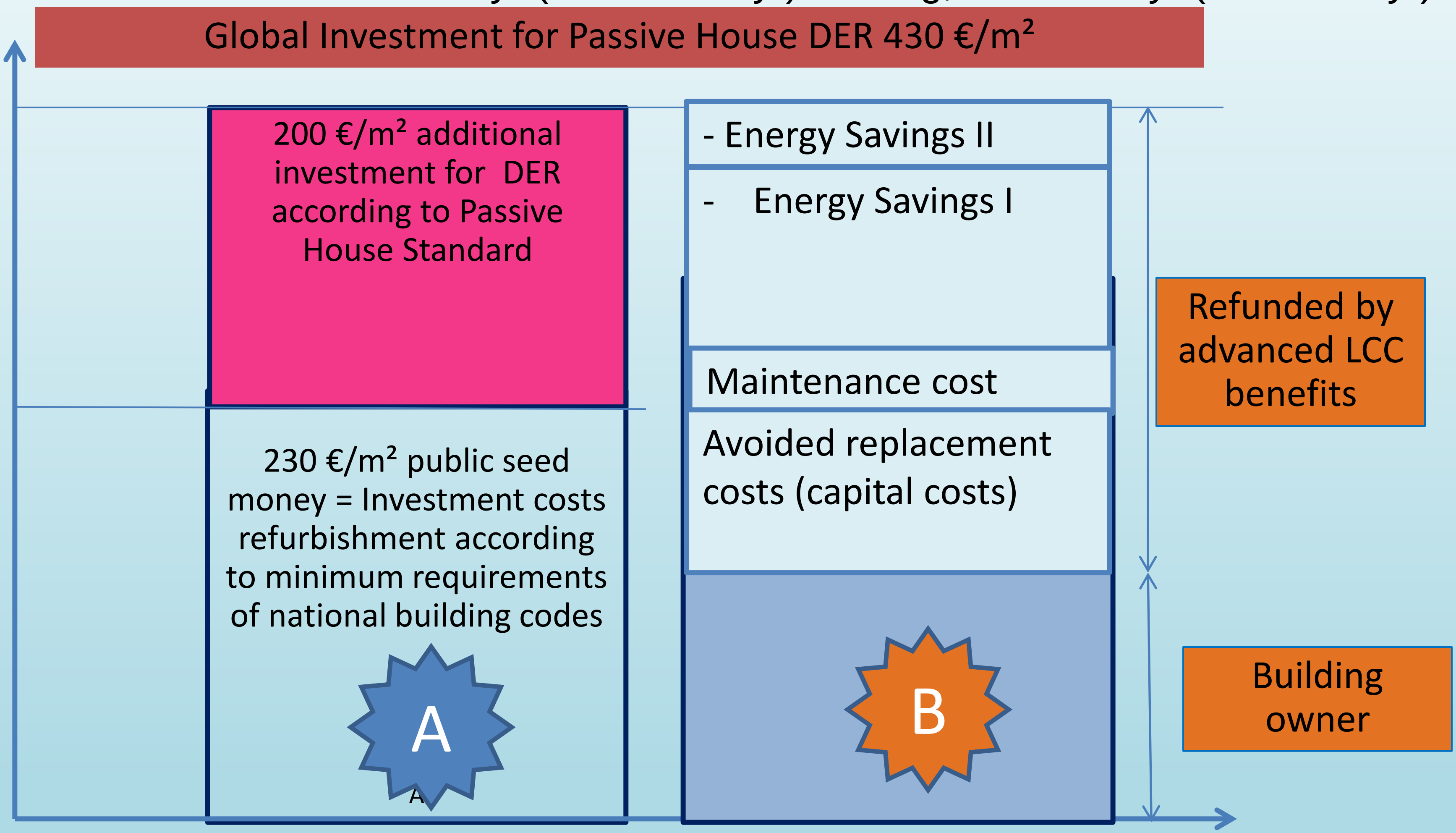
B

Scenario B assumes that **no seed money is available** and that global investment costs have to be considered for refinancing- this is the case in many countries with public austerity programs- the consequence are refurbishment rates of <1% instead of 2% of the building stock floor space per year :

- **The decision making is different in B cases:**
  - **Can we afford to repurpose the building**
  - **Which amount can DER advanced LCC benefits can contribute to the global budget? How much funding will be brought up by the building owner?**
- In some EU countries 5-15% of the additional DER costs are provided in low interest rate grant programs subsidizing by single up- front payments or interest rate rebates (e.g. KfW – 1.5%)
- To keep pay back periods in reasonable dimensions (20- 25yrs) energy is not the only benefit to be considered: demand for ***ADVANCED LCC***
- ***Case studies*** in Belgium and Germany show that global DER investment costs can be refinanced by advanced LCC within pay back periods of 16 to 25 years (office buildings and dormitories pre- ref. EUI 180 kWh/m²yr)

Scenario A and B in a German case study: how advanced LCC can contribute to a global DER budget

Initial situation: office 180 kWh/m²yr (59 kBTU/ft²yr) heating,30 kWh/m²yr (9 kBTU/ft²yr)



Advanced LCC: How to leverage non- energy cost- benefit calculation of DER projects

Life Cycle Costs according to standards on LCAnalysis [ISO 14040-44], European standards [EN 15804] and [EN 15978] with regard to LCA, and other reference documents [ILCD 2010a], [ILCD 2010b], [ILCD 2010c] and national standards such as German Industrial Standard VDI 2067, B1.

- Part- LCC as it only considers the usage phase of the building (not construction and de- construction phase)
- Part- LCC lifespan/service life of building components and elements: period in which their performance meets initial requirements (ISO 15868)
- Most of LCC analysis in the field of building ***only consider the energy and investment related LCC such*** as interest rates, pay back rates, energy savings and energy cost savings- this makes sense for any “shallow” approach in building refurbishment
- As DER is increasing the scope of investment it also offers bottom- line benefits beyond energy related LCC which are mostly overlooked in the present decision making process
- Major stakeholders (EEFIG) demand for accounting and capturing the additional value of these benefits in the business balance sheet can drive decision making on DER…. But KEEP IT BANKABLE

LCC- cost benefits of DER

	Life Cycle Cost	Calculation / M&V approach	Variations and Values
1	Energy savings: effects from improving the e-performance of equipment by maintenance or replacement	(kWh savings x energy price) vs. Baseline (kWh consumption x energy price)	Fixed or flexible energy price; in DER it is expected to at least reduce by 50% Values: Germany office building stock 7-14€/m²yr
2	Energy savings II- fuel switch to renewables/CHP	kWh *RE replacing fossile* x energy price *(RE- fossile)*	kWh replaced by RE; fixed or flexible energy prices;
3	Reduced maintenance I	Maintenance costs for replaced, worn down equipment at the end of its life cycle as a percentage of the new investment value	Average percentage value or end of life cycle value (➔ graph LCC maintenance) Values applied at the market: - 0,25$/ft² in US; EU: 2 to 5 €/m²
4	Reduced maintenance II	Downsizing of investment in a DER bundle means reduction of investment cost related maintenance	A component downsized by 30% reduces maintenance costs by 30% (heating supply 0,3-1 €/m²)
5	Reduced operation costs I	Building automation reduce operation workloads	Consider workplans and operation schedules individually

LCC- considerable cost benefits of DER

	Life Cycle Cost	Calculation	Variations and Values
6	Insurance costs I	Building compontents replaced achieve lower premiums and improved protection against loss	EU: compared to pre- refurbished status: -2 up -4€/m^2
7	Rental Costs for floor space	m^2savings x rental rate or m ² savings x investment costs additional floor space x annuity	DER may contribute to more flexible room concepts, reduced space demand for mechanical systems and additional floor space created by insulated walls, attics 10- 31 €/m^2 overall
8	Reduced absence costs	Relationship between indoor climate,lighting and absenteeism	Few case studies assessed the relationship: 30- 40% less absenteeism; very few cases have been capturizing this benefit (➔ www.comfortmeter.eu

LCC – Energy saving I and II

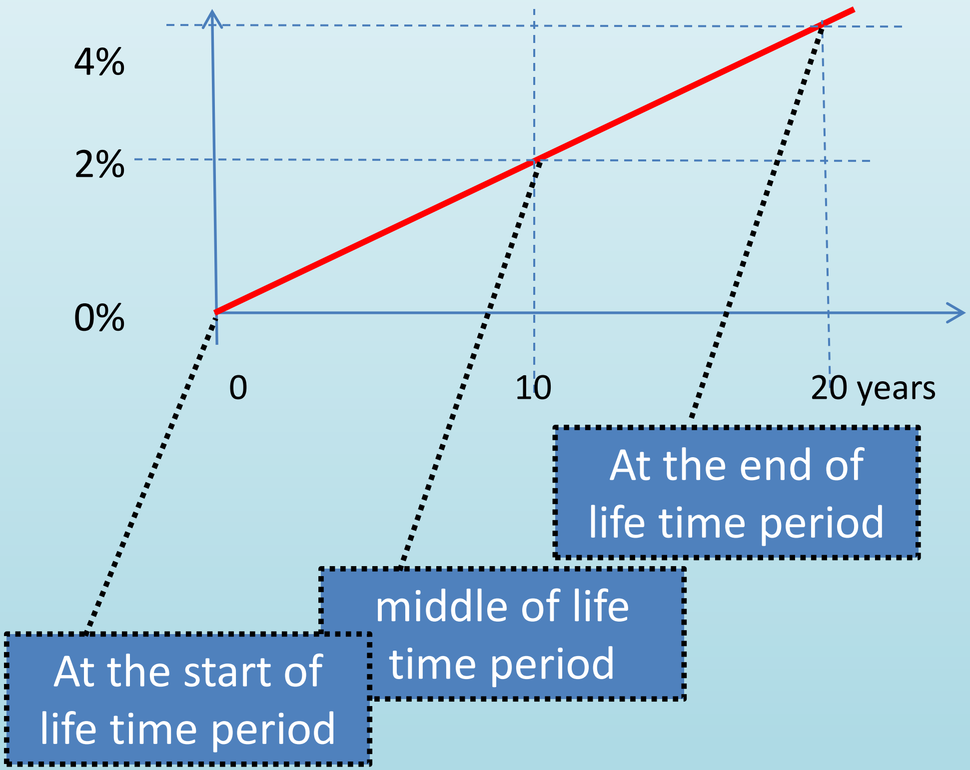
Energy saving I and II in DER

- Improving the energy performance by thermal insulation, improved supply and demand appliances such as new boilers, ventilation, air conditioning etc.
- **Energy consumption baselining:** Definition of an energy baseline including heating and cooling degree adjustment, considering a 365d/year and a “normalized” operation and usage of the building (impacts of un- normal disturbances such as construction, hazards etc. are neutralized.
- **Energy price baselining:** collection of current or future price scenarios for existing and RE which allow for appraising the energy savings and the value of fuel- switching
- **Example:**

	Heating	Price 1	Price RE
Energy /Pricebaseline	100,000 kWh/yr	0.06 $/kWh	0.03 $/kWh
Energy saving I	50,000 kWh/yr	3,000 $/yr	
Energy saving II (fuel switch)	40,000 kWh in RE		1,200 $/yr
Total	4,200 $/yr		

Advanced LCC- avoided maintenance I

Graph: Avoided Maintenance



In most of EU countries:

- maintenance costs are estimated as a percentage value of the primary investment over the technical life time of this investment
- Example:
  - Investment of a boiler: 50k$
  - Life time: 20 yrs
  - Germany: VDI 2067 (industrial standard) gives average value for boiler incl. installation of 2%

  ➔ 50k$ x 2% = 1k$ maintenance costs in average over 20 years

Worn out equipment at the end of life cycle has to be considered not at 2 but at 4%

➔ 50k$ x 4% = 2k$ maintenance cost savings

Advanced LCC- Insurance Cost

Insurance Cost Reduction

- In DER projects typically larger parts of the technical installation and infrastructure is replaced. Insurance companies reduce premiums and pricing discounts to qualified and assessed DER projects (1) With ++ (5-10%), + (0-5%), - (no discount)
- **With total costs of 4- 8 €/m² for pre- refurbished buildings cost saving**

Insurance Risks DER measures	Fire&Wind Damage	Ice, Water Damage	Burst Pipe Insurance	Boiler and Machinery insurance	Power Failures
Windows	++	++			
Thermal envelope					
Duct and pipe systems	++	+	++	+	
Electrical system				+	++
HVAC	++	+	++	++	+

Advanced LCC – Space Optimization- Rent Cost Savings

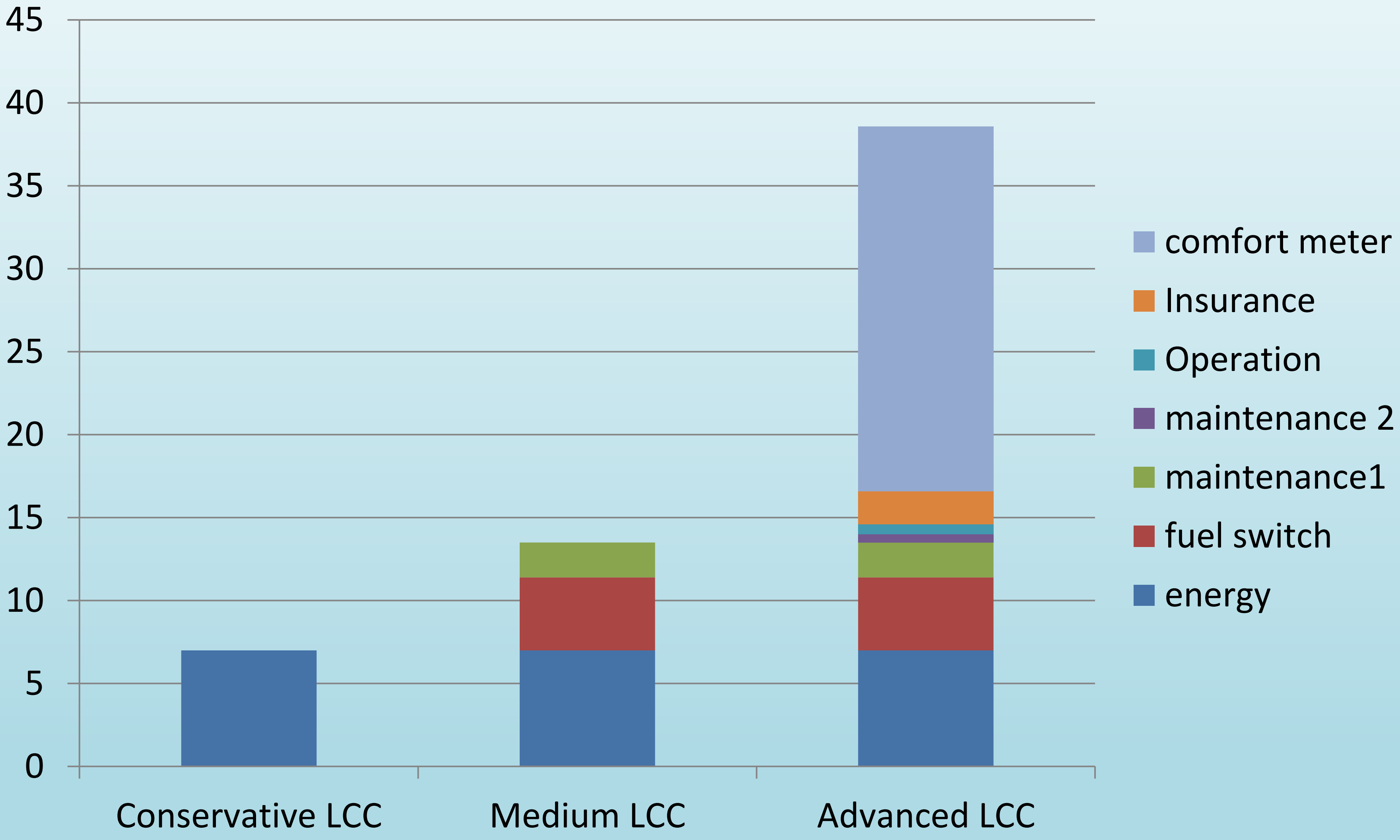
Space Optimization

- Deep (Energy) Retrofits can downsize and consolidate mechanical equipment to (➔ Maintenance Cost Reduction II) and to free up space
- In high- cost rental markets such as NYC, Frankfurt space optimization has become a driver of value for DER (2)
- Deutsche Bank Towers, Frankfurt:
  - DER of Deutsche Bank Twin towers built in 1980-85
  - Major impulse for DER in 2005: fire protection system had to be refurbished due to new security regulations and fire protection codes
  - Development of a sustainable DER concept GREEN TOWERS with daylight concept (open spaces), high efficient triple pane façade glazing, downsizing of HVAC system by reducing air exchange rate from 6 to 1.5 and by integration of mechanical windows into ventilation concept, water saving concept
  - DER was accomplished by 2011 with a total investment of 200 M€ (3.300 €/m²)
  - Water saving: 44000m³/yr., Light power demand from 34 W/m² to 16; site energy savings of 67% compared to baseline.
  - 1.800 m² (4%) space freed up from downsizing HVAC
  - Appr. 1.000 m² gained from advanced flexible working place concept enabled by DER
  - Assumed annual rental rate: **approx. 400 – 450 €/m²** ~ 1M€/yr of space optimization benefits
- Another attractive best case study is the CISCO refurbishment (CISCO IT CASE STUDY, 2007) averaging spaces freed up by more than 30% by a flexible workplace concept

- (2: How to calculate and present DR value, RMI, 2014)

Advanced LCC – cumulated values €/m² for 3 scenarios

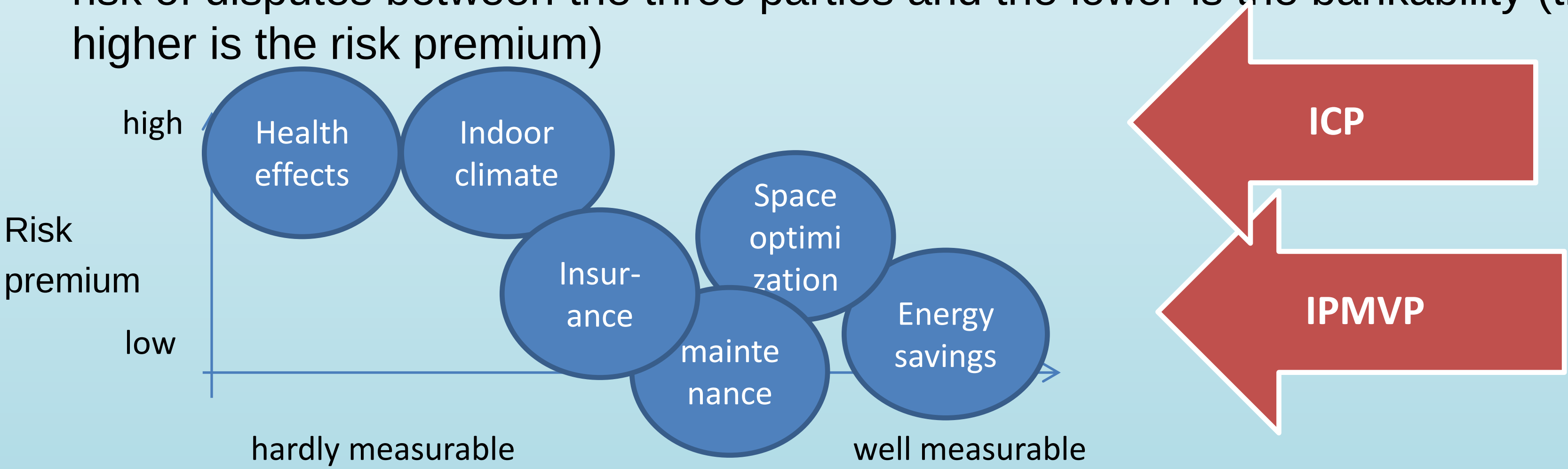
10 €/m²yr = annuity of investment of 110€/m²



Accountabilty of advanced LCC benefits

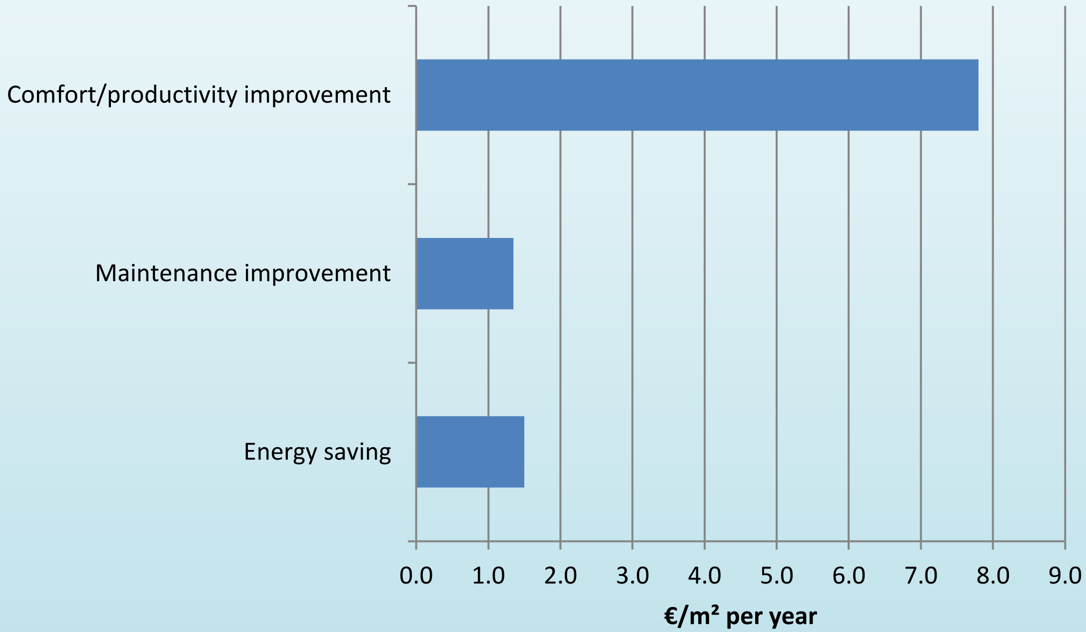
Accountability resp. Bankability of advanced LCC approaches:

- Bankability means that the LCC are described in way that allows to measure, monitor and verify them according to defined and mostly standardized methodologies which are understood and agreed by the DER provider, the building owner and the financier (which may also be an ESCO)
- The more subjective the monitoring and verification process is the higher is the risk of disputes between the three parties and the lower is the bankability (the higher is the risk premium)



Graph 3: Relation between risk premium and measurable impacts

Accountability – Belgian EPC experience



- Factor4 data on net cost savings in an EPC-project (€/m² office per year)
- Comfort has been made a part of the benefits of an EPC project
- Building owner has collected experience with absence/sickness days at various climate conditions
- Weekly polling by users ➔ remuneration of the ESCO
- In addition "maintenance improvement"

www.comfortmeter.eu

Advanced business Models for DER: advanced EPC

Business models:

- To increase the financing capacities of building owners Advanced LCC must be bankable ➔ ESCO providing a performance guarantee
- In public sector a (federal or public) facilitation unit needs to prepare and guide the process and take over responsibility for purchasing process;
- a technical due diligence //loan guarantee program will enable private money to float into the funding process (which needs not to be done by the ESCO per se)
- Risk allocation: so far the performance risk has been allocated at the building owner. Now this will be moved gradually to the ESCO (f (experience)
- Maintenance: of the thermal envelope needs to be specified very clearly
- Architectural pre- design has to be provided by the building owner
- No active penalization in case of failure of the performance guarantee
- Allow longer adjustment time (3 years)
- Standardized M&V and risk stipulation

Business Models for DER: advanced EPC

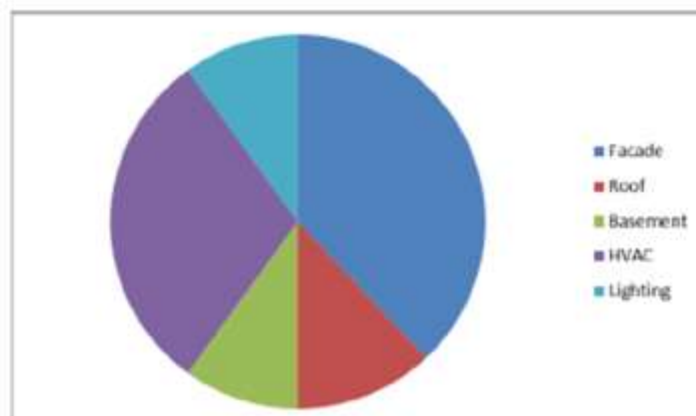
Dormitory, DER ESPC including thermal envelope, Mannheim

Buildings Included:

- 4 dormitories

Project Facts:

- **Year of Construction:** 1960
- **Square Meters useful area:** 4 buildings each 2667 m²
- **EUI 120 kWh/m² yr heating; 33 kWh/m²yr el. Power**
- **Energy& Water Cost baseline: 304.500 €/yr**
- **Maintenance costs: 143.000 €/yr**
- **Investment Value:** 1 780 000 €
- **Annual Energy Cost Reduction:** 101 800 €
- **Payback Period** –19 years
- **Energy Reduction Percentage:** 67%
- **ESCO:** tbd
- **ECMs based upon Investment**



Conclusions

- DER creates additional benefits in comparison to staged and shallow refurbishments which have to be monetized to increase the cost effectiveness of DERs
- To increase the financing capacities of building owners Advanced LCC must be bankable which means a) somebody (ESCO) needs to take responsibility by providing a performance guarantee b) a widely standardized technical due diligence process such as ICP or SEAF is used
- First approaches to integrate advanced LCC into EPCs have been successfully started
- The public sector needs to blend private and public funding to facilitate DER; if public funding is not available advanced LCC can contribute to finance the global investment costs
- To make advanced DER EPC work standardized processes are needed, a significant number of projects, a learning phase for both sides ➔ tasks for a centralized program management entity for a limited time

Questions, comments??

Ruediger.Lohse@kea-bw.de