Task 16 "Energy Services"
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Building Deep Energy Retrofit: Using Dynamic Cash Flow Analysis and Multiple Benefits to Convince Investors

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Introduction

1. **Deep energy retrofit** (DER) of the **existing building stock** is a meaningful strategy to reduce fossil fuel consumption and CO_2 emissions
2. For Europe alone, **cumulative investment demand for DER** is estimated at close to **1,000 billion EUR until 2050** (BPIE 2011).

=> Public expenditures and political measures can help to stimulate DER, but **substantial private sector investments are required to achieve significant results**.

Research questions + goals

1. **Economic and financial viability of DER project cash flows** (CF) and **sensitivity analyses**?
2. How to **communicate DER investment opportunities and risks in a business language** that potential investors are familiar with (reporting, financial engineering, due diligence …)?

3. Can **'Multiple Benefits of Energy Efficiency'** (IEA 2014) **capture additional benefits, revenues and drivers** to make the business case more attractive investors **on the microeconomic/project level**?

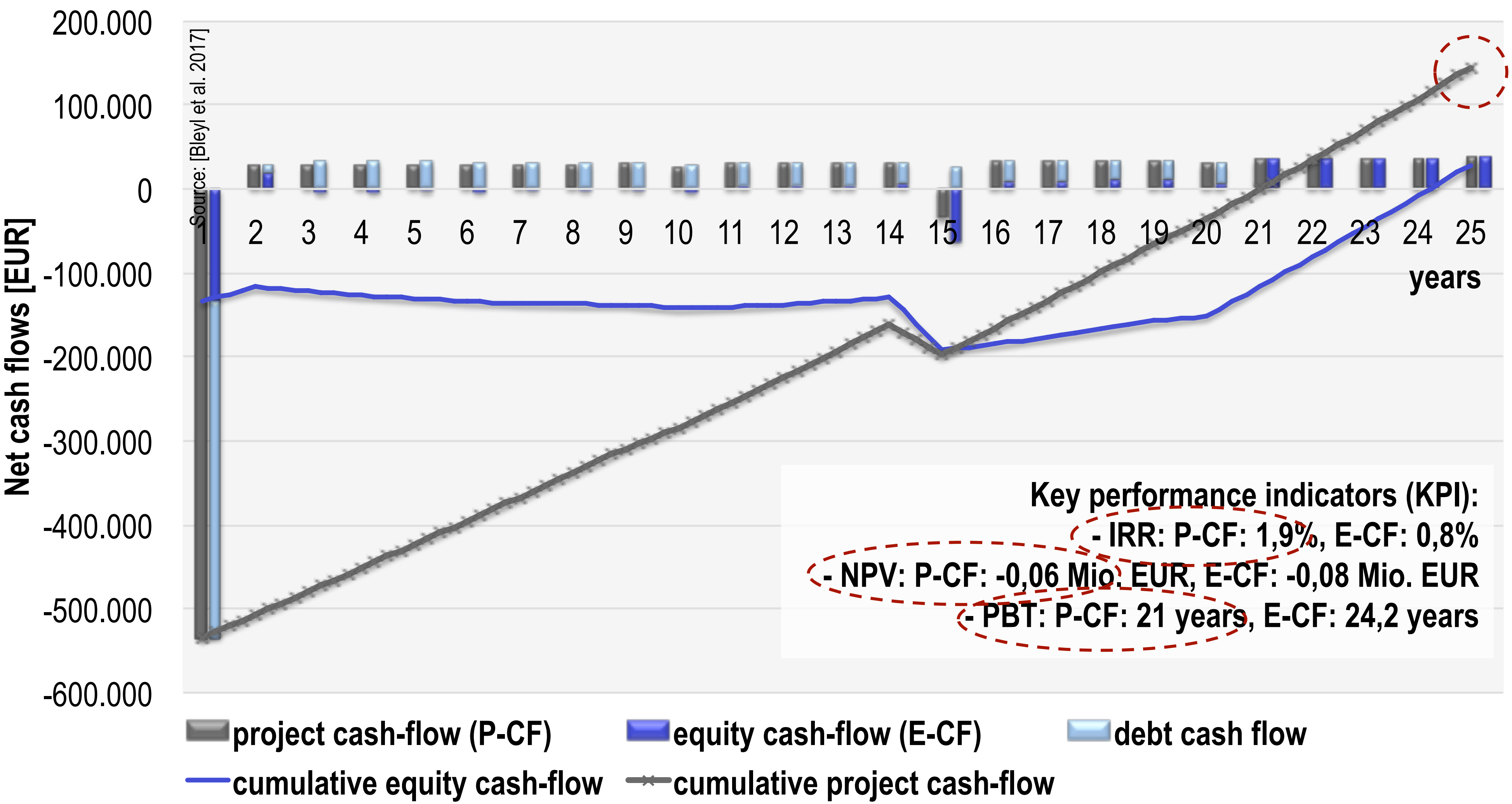
Methods of approach

1. **Case study**:
   Office building DER to ‘Passive House’ standard in Germany
2. **Investment analyses:**
   Dynamic Life Cycle Cost Benefit Analysis (LCCBA) **model** based on project, equity and debt cash flows
   => **Economic** & **financial KPIs, sensitivity** & **risk analysis**
3. **Multiple Benefits** (MB):
   - Development of a **MB classification grid**
   - **Literature research** with a focus on individual ‘Participant’ benefits on the **project level** (conservative values)

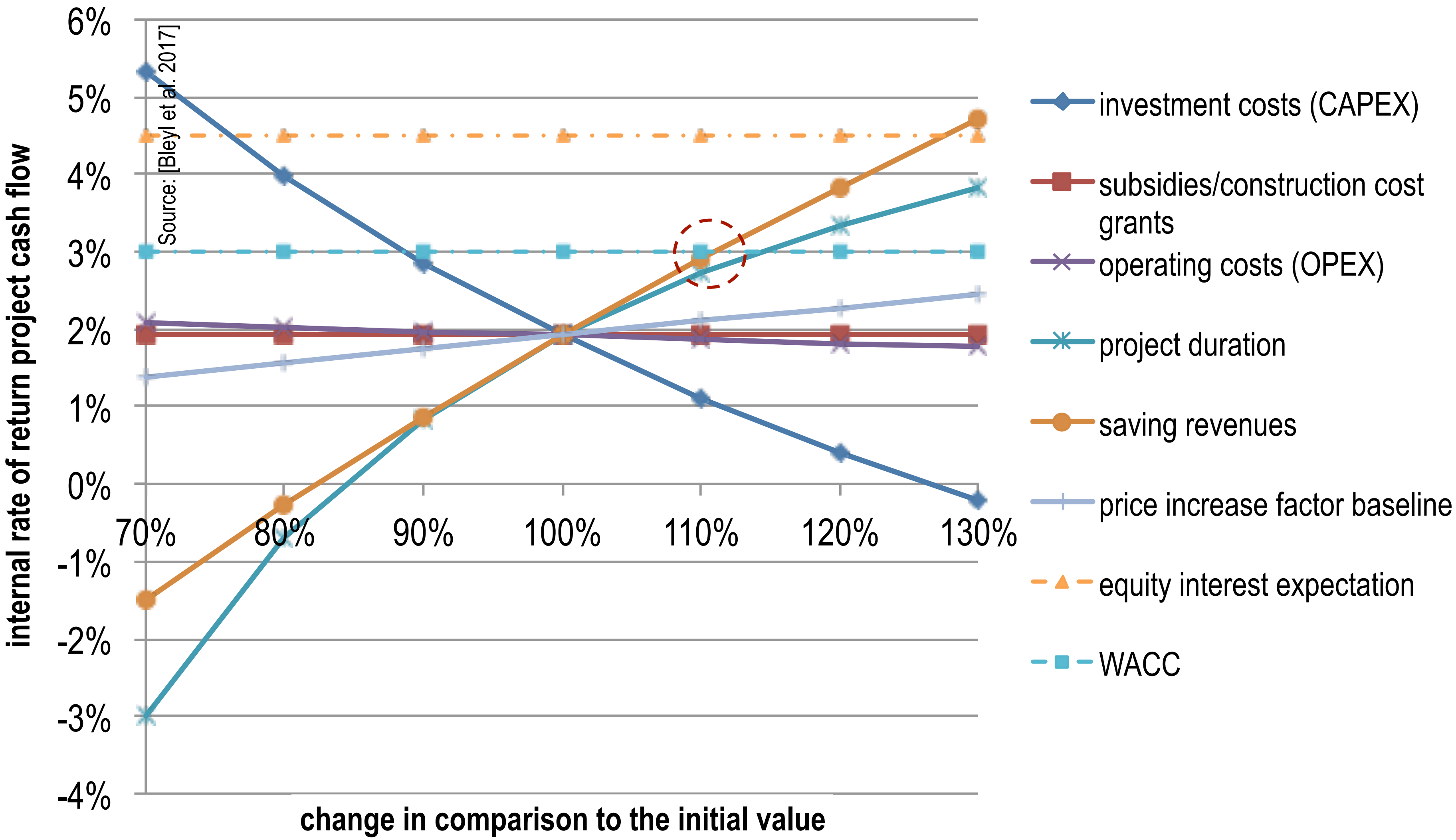
Office building case study:
Deep Retrofit to ‘Passive House‘ standard

- ⇨ **Floor area**: **1.680 m²; Heat + electricity baseline: 45,000 EUR/a**
- ⇨ **CAPEX for energy retrofit only**: **560,000 EUR = 330 EUR/m²**
  (+ ‚Anyway cost‘: 170 EUR/m²)
- ⇨ **After DER: Heat cost savings: 88%, electricity cost savings: 17%**

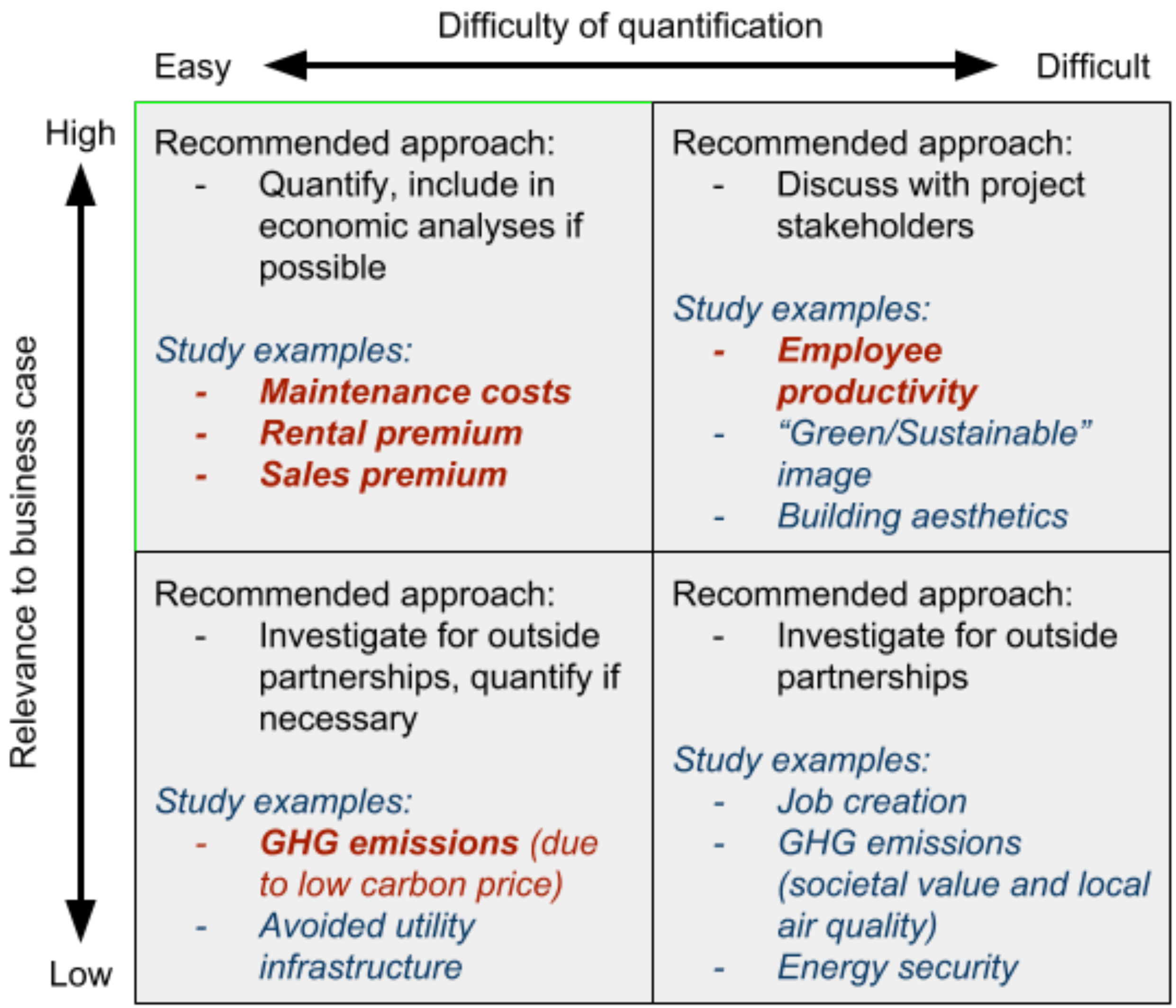
DER case study: Net project, equity and debt cash flows (annual and cumulative)



Sensitivity of project IRR to relative change of input parameters



Multiple Benefits classification grid



[Source: Bleyl et al. 2017]

Valuated DER Multiple Benefits

Multiple Benefits of DER	
1.	**Work productivity increase** (0.3%)
2a.	**Rental income increase** (1 - 5.3%)
2b.	**Building sales price increase** (2.5 - 6.5%)
3.	**CO_2 savings** (5 - 79 EUR/t)
4.	**Maintenance cost savings** (2.1-3 EUR/m2/y)
5a.	**Energy cost savings project term** (25 years)

[Source: Bleyl et al. 2017]

Pecuniary values of DER Multiple Benefits
Metric: EUR/m²: 1. per year; 2. as NPVs

	Multiple Benefits of DER	Range	Valuation: EUR/ (m^2 * y)	Valuation: NPV: EUR/m^2
1.	Work productivity increase (0.3%)	Lower	8.0	169
		Upper	8.0	169
2a.	Rental income increase (1 - 5.3%)	Lower	1.2	25
		Upper	6.4	134
2b.	Building sales price increase (2.5 - 6.5%)	Lower	100	
		Upper	260	
3.	CO_2 savings (5 - 79 EUR/t)	Lower	0.2	5
		Upper	3.8	79
4.	Maintenance cost savings (2.1-3 EUR/m2/y)	Lower	2.1	44
		Upper	3.0	63
5a.	Energy cost savings project term (25 years)	Lower	16.8	354
		Upper	16.8	354
5b.	Add. energy cost savings over techn. lifetime (40 y)	Lower	16.8	157
		Upper	16.8	157

[Source: Bleyl et al. 2017]

Annotation:

NPV over 25 years,
1,5%/year price increase,
WACC 3% as discount rate

Conservative values

Multiple Benefits of DER: Pecuniary values => accountability to different stakeholders

	Multiple Benefits of DER	Range	Valuation: EUR/ (m^2 * y)	Valuation: NPV: EUR/m^2	Beneficiaries – Different owner perspectives: Property develop.	Occupant -owner	Lessor -owner	Tenant
1.	**Work productivity**	Lower	8.0	169	-	169	-	169
	increase (0.3%)	Upper	8.0	169		169		169
2a.	**Rental income increase**	Lower	1.2	25	-	-	25	-25
	(1 - 5.3%)	Upper	6.4	134			134	-134
2b.	**Building sales price**	Lower	100		100	[100]	[100]	-
	increase (2.5 - 6.5%)	Upper	260		260	[260]	[260]	
3.	**CO_2 savings**	Lower	0.2	5	-	5	-	5
	(5 - 79 EUR/t)	Upper	3.8	79		79		79
4.	**Maintenance cost**	Lower	2.1	44	-	44	44	-
	savings (2.1-3 EUR/m2/y)	Upper	3.0	63		63	63	
5a.	**Energy cost savings**	Lower	16.8	354	-	354	-	354
	project term (25 years)	Upper	16.8	354		354		354
5b.	**Add. energy cost savings**	Lower	16.8	157	-	157	-	[157]
	over techn. lifetime (40 y)	Upper	16.8	157		157		[157]
	Totals			Lower NPV:	100	729	69	503
				Upper NPV:	260	822	197	468

Source: [Bleyl et al. 2017]

[Source: Bleyl et al. 2017]

Discussion and conclusions (1/2)

1. *Beyond ‘engineering economics’:* Cash flow model results provide **solid grounds for DER business case analysis, project structuring, financial engineering**
2. Also **bridging the ‘language gap’** to potential investors and supporting **policy design** are important applications.
3. *Bad news:* CFs from future energy cost savings are **not a stand-alone business case** (not even with 25 years investment horizon).
4. *Good news:* CFs can **co-finance investments substantially** (up to 85% in case study; OPEX to CAPEX)
   => **rather small co-financing needed**

Discussion and conclusions (2/2)

5. *More good news from MBs:* **DERs can generate tangible and quantifiable benefits on the project level** (Valuated: higher rents & real estate values, maintenance cost & CO_2 savings and higher work productivity).
6. These MBs can offer meaningful **contributions to make a business case more attractive** and help to identify **strategic allies for DER programs and project development**.
7. However **'split incentive' dilemma requires differentiation between different types of investors and tenants.**
8. Furthermore, the approach can support policy makers to develop policy measures needed to achieve 2050 goals, in particular **facilitate private sector investments**

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ENERGETIC SOLUTIONS
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Thank you!

Questions and remarks welcome!

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