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IEA Annex 61 – key messages

- IEA EBC Annex 61 is a research program targeting technical and business models for Deep energy retrofits
- DER strategies with a dramatically increased refurbishment rate are needed to achieve EU 2050 carbon neutral building stock
- A DER strategy will demand for private equity money to get engaged in EE comparable in a way as it happened in RE sector
- To involve private sector funding in the DER market the main weak points of DER market have to be solved: lagging data and experience records, uncertainity and lack of credibility of process, investments and results.
- Performance related business models must replace the business as usual
- Energy savings from a DER can achieve 22- 89% of heating savings
- Involving non- energetic benefits by monetizing them into the account of a DER business model will create pay back periods and NPV attractive for private funding

Introduction

- Governments worldwide are setting more stringent targets for energy use reductions in their building stocks:
  - US federal buildings: E.O. 13693 § 3(a)(i) reduce energy intensity by 2.5% annually until 2025
  - EU EBPD targets carbon neutral building stock in 2050
- BPIE& GBPN Studies and IEA: To achieve these goals, two major aspects will have to be tackled
  - significant **increase in both the annual rates of building stock refurbishment** and energy use reduction, for each project (EU: refurbishment rate of 3% p.a., USA: 3% p.a. site energy reduction compared to CBECS 2003) AND
  - follow a **Deep Energy Retrofit** strategy in their building stock, targeting energy savings of > 50- 80% or < 60kWh/m²yr (cz 5).

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Business and Technical Concepts of Deep Energy Retrofit of Public Buildings IEA EBC Annex 61

EBC
Energy in Buildings and Communities Programme

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Major Objectives for a DER strategy

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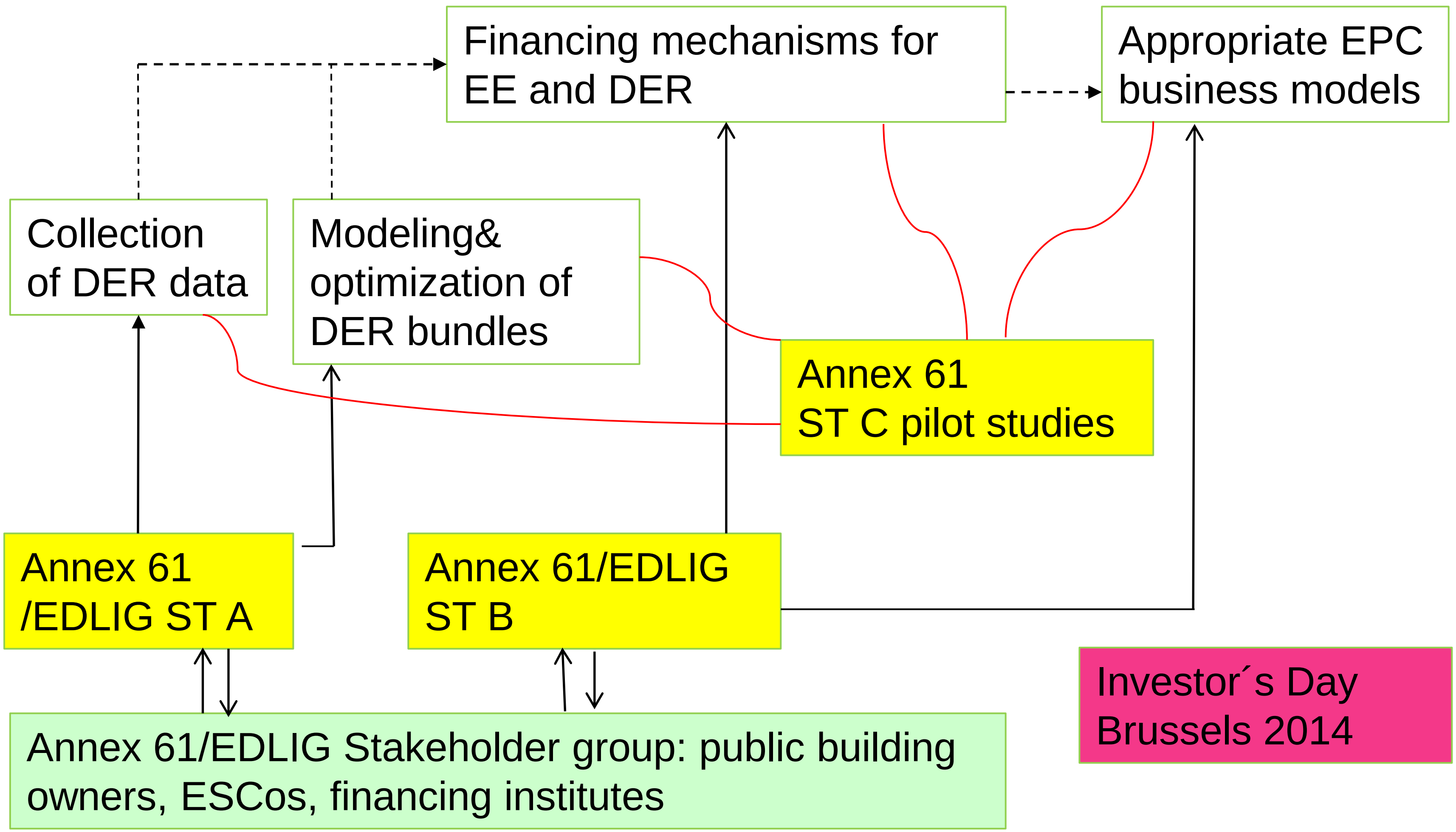
- **Financial:**
  - to comply with EU 2020 targets values € 60- 100 bn/yr which is at least 3 times of the budget spent in recent years
  - Investment needs will not be attained by "the market" but by combined public funds an other drivers (EEFIG Report)
  - DER and other EE measures are not "investor ready"
  - Business as usual is mostly "salami attacking" picking the low- hanging fruits first
- **Business Model**:
  - Existing "owner directed" business model create split incentives and do not support energy and life- cycle cost efficiency
  - Savings and other benefits are not bankable (no guarantee)
  - Knowledge loop is not closed between planning, operation and performance
  - ESCOs are not yet ready to enter into DER (unknown risks)
- **Lack of technical knowledge:**
  - While components are well known the bundling and optimization of bundling still needs strong support from r&d

Lack of experience records
DATA!!

How IEA EBC Annex 61 helps the case



Current status

- **In this presentation we will focus**
- **the assessment of accomplished DER projects,**
- **the modeling for optimization of bundles and**
- **the approaches for a business model**

A 61 – DER case studies- targets

Target: Business models based on guaranteed (bankable) cash- flows

What we want to assess:

- Assessment of accomplished DER projects
- Data! Availability of accurate experience records
- Impacts of DER bundles at specific building usages and types
- Risk related aspects:
  - Reliability of modeling
  - Gap between prediction and performance
  - GapTolerable boundaries for LCA
- Cost data- synergetic savings?
- Experiences with business models- strengths and flaws

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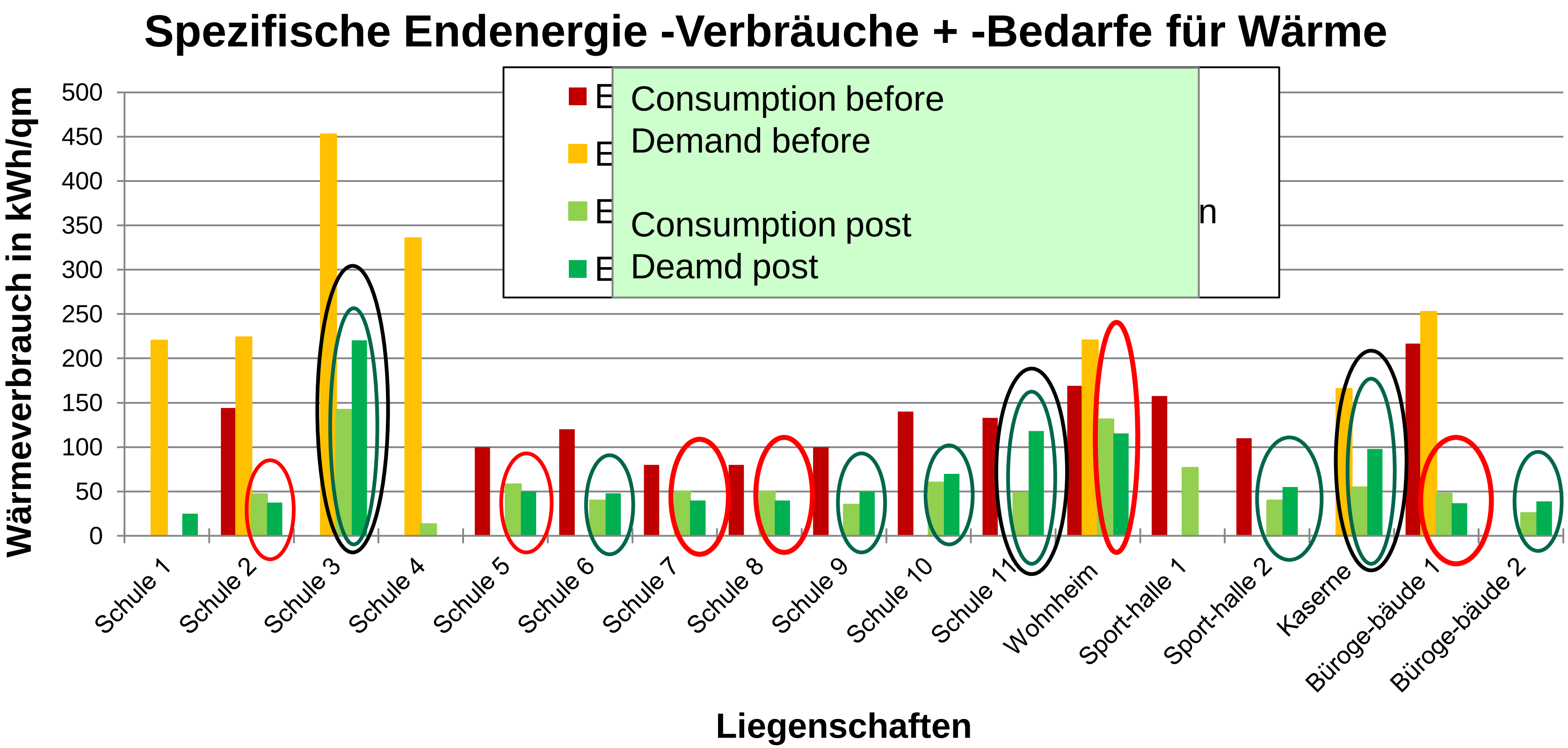
A 61 – DER case studies- lessons learnt in DE- collected data

Model: robustness, rebound/ prebound effects;adjustment; verification (+optimization)

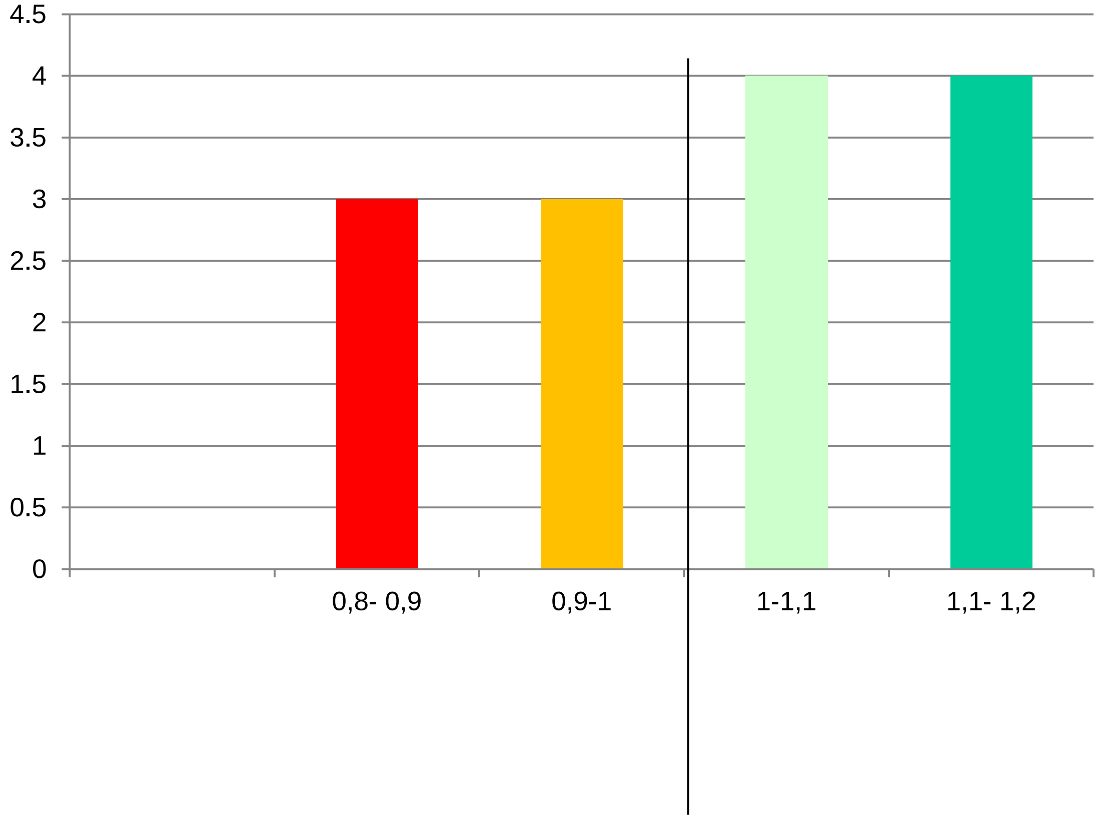
- Consumption before DER
- Consumption post DER
- DER measures (implemented)
- Usage zones, schedules, comfort parameters
- Climate data
- Modeled demand post DER
- Modeled energy demand before DER

A 61 – DER case studies- lessons learnt in DE



Germany - Results from 14 DER Case Studies

Ratio of predicted and monitored post retrofit energy consumption f b/v for 14 buildings



DER measure bundles and their impact- savings 22- 89%

Project	Schule 1 Highschool	Schule 2 (landmarked high school.)	Schule 6 (high school)	Schule 7 (high school)	Schule 9 (high school)	Schule 11 (high school)	Wohnheim (Dorm)
Net floor area, heated (m²)	1.017	4.439	1.636	10.086	3.509	1.774	2.995
Measures							
Windows (Uw [W/m²K])	0,77	1,00	0,9 / 1,3	1,6	1,20	1,30	1,30
Facade/(UF [W/m²K)	0,13	0,34	0,17	0,19 / 0,24 (a)	0,20	0,18	0,23
Roof (UR [W/m²K)	0,07	0,22	0,14	0,14 / 0,19 (a)	0,13 / 0,15(a)	not touched 0,2	0,18
Basement floor (UB [W/m²K)	0,09	0,32			0,18		0,21
Basement ceiling (Uw [W/m²K)	0,14			0,22 / 0,28(a)			
Heating system	(electric heat pump)	(Gas-heat pump)	Pellet	In progress	District heating	CHP /gas boiler	In progress
AC	Heat recovery 75%	No heat recovery	Heat recovery and presence detector	-			
Lighting	T5 reflect.	T5	T5	Partial	partial	T5/LED	Not available
Einsparungen							
Site energy savings [%] (modeled/monitored)	(n.a/89)	(83/67)	(60/67)	(50/38)	(50/65)	(11/63) (b)	(48/22)

a): different U values have been applied due to constructive restrictions
b): initial modeling was done with a DIN 18599 standard software which led to inappropriate predictions

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A 61 – DER case studies- lessons learnt in DE

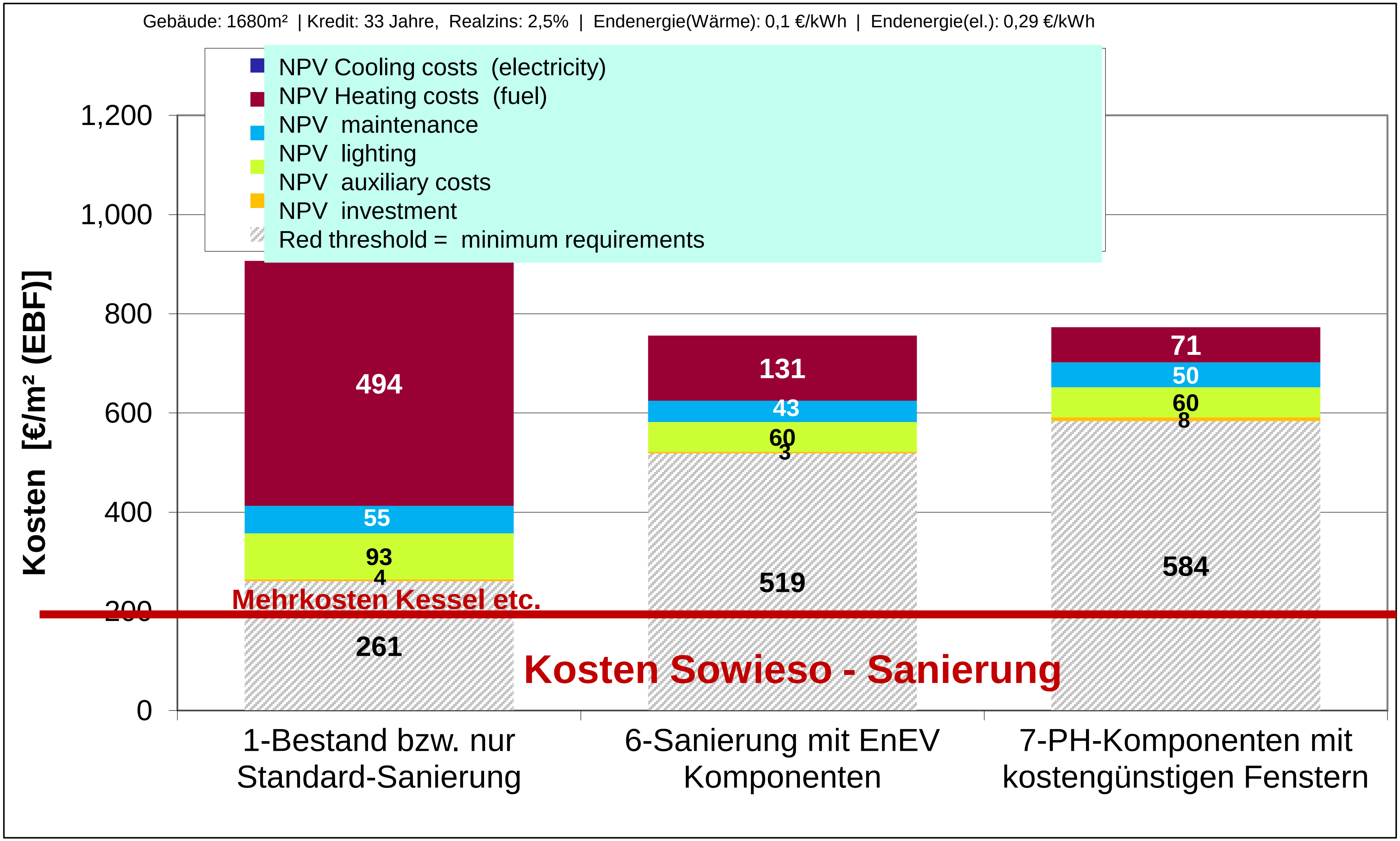
- Inaccurate assumptions for the base case (scenario before refurbishment) which led to wrong modeling results (*rebound* effect according to IWU definition)
- Usage of inaccurate tools for modeling
- Inaccurate usage of windows and ventilation system offset the beneficial effects of increased air tightness
- Building users foiling the building control system
- Building users tend to increase the indoor room temperature minimum 1 up to 3°C over the level assumed in the modeling

A 61 – DER case studies- Optimization of DER bundles

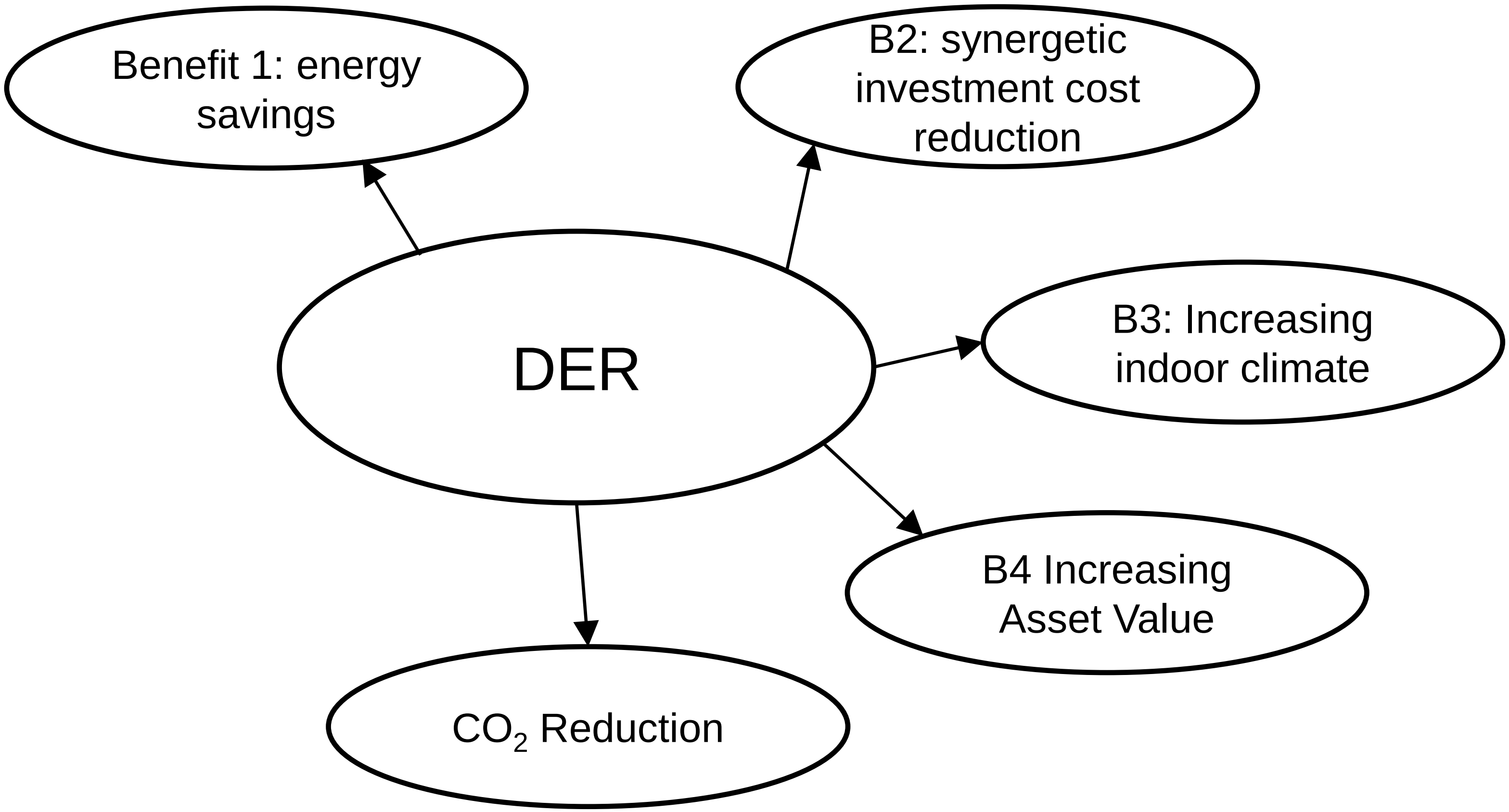
- Case study modeling
- Cost attractiveness of bundles
- How to achieve synergetic investment cost savings
- Investment costs from recent procurement process (summer 2014)

	1. Baseline (pre- DER)	6. DER with German code for new buildings	7. PH Refurbishment
Roof [W/m²K]	U = 0,7	d = 160 mm U = 0,2	d = 400mm U = 0,085
Ext. Wall [W/m²K]	U = 1,3	d = 140 mm U = 0,24	d = 300mm U = 0,11
Basement ceiling [W/m²K]	U = 1	d = 85 mm U = 0,3	d = 120 mm U = 0,23
Windows [W/m²K]	U_g=2,9 U_f=4,5	U_g=1,3 U_f=1,3	U_g=0,64 U_f=0,74
ventilation	Exhaust air (partial)	Heat recovery exhaust air	Heat recovery >80%
cooling	-	Ventilation by night and reduced out door temperature	
Domestic hot water	Distribution	Detached flow type heater	
Lighting/ control	T8	T5 presence+ daylight controlled	

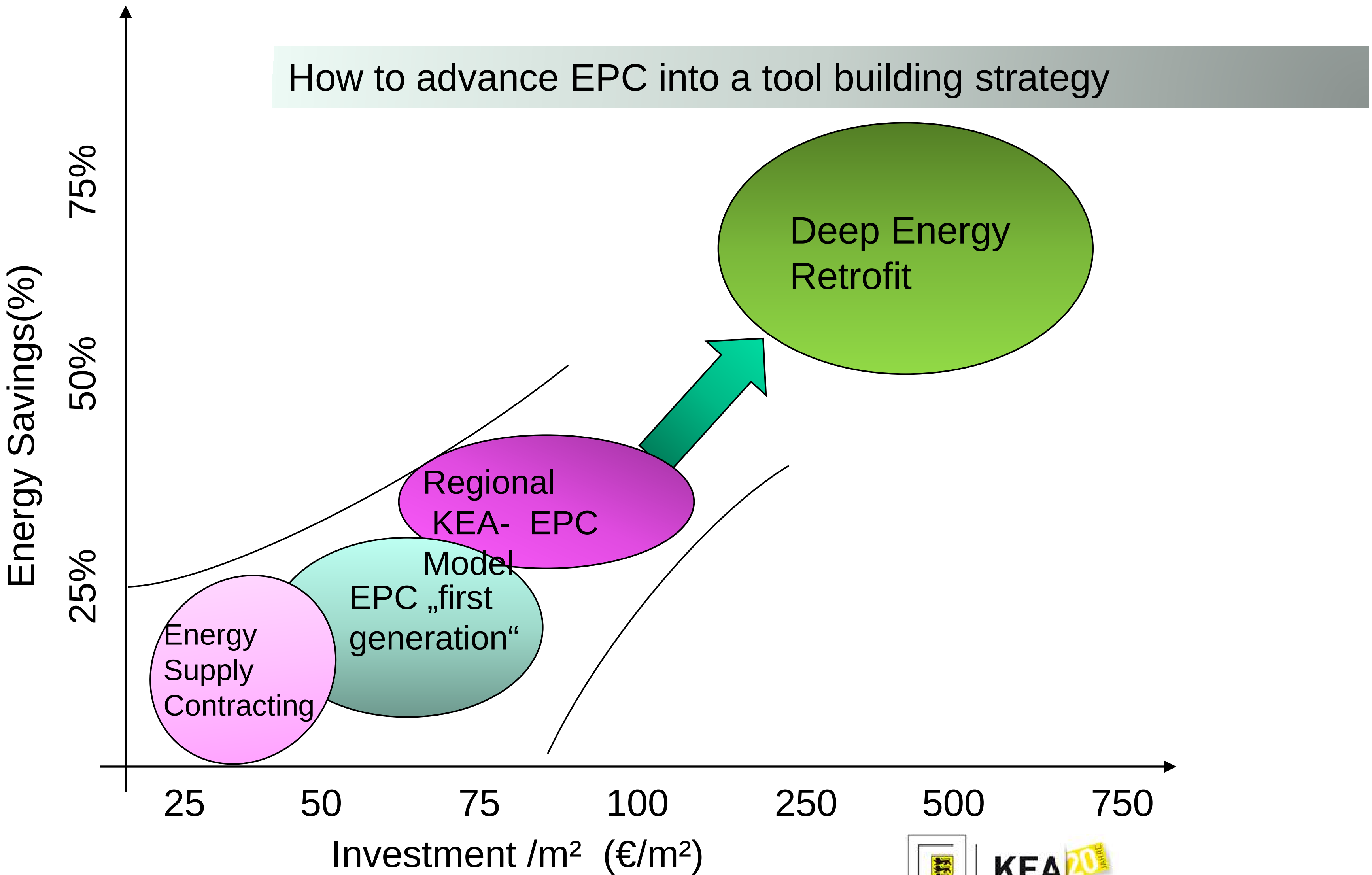
Partly LCA Net Present Value analysis



A 61 – DER business models- how to leverage DER



Improving the EPC business model towards DER



Development of advanced EPC

a) Lessons learnt from accomplished DER: Gather case study information on business models used in existing deep retrofit projects ➔ planning tools, impacts and investment costs of DER measure bundles, quality assurance mechanisms.

Annex 61 Subtask A

- Reliable planning tools
- Impacts of DER measure bundles
- Investment costs for DER bundles
- Quality assurance mechanisms

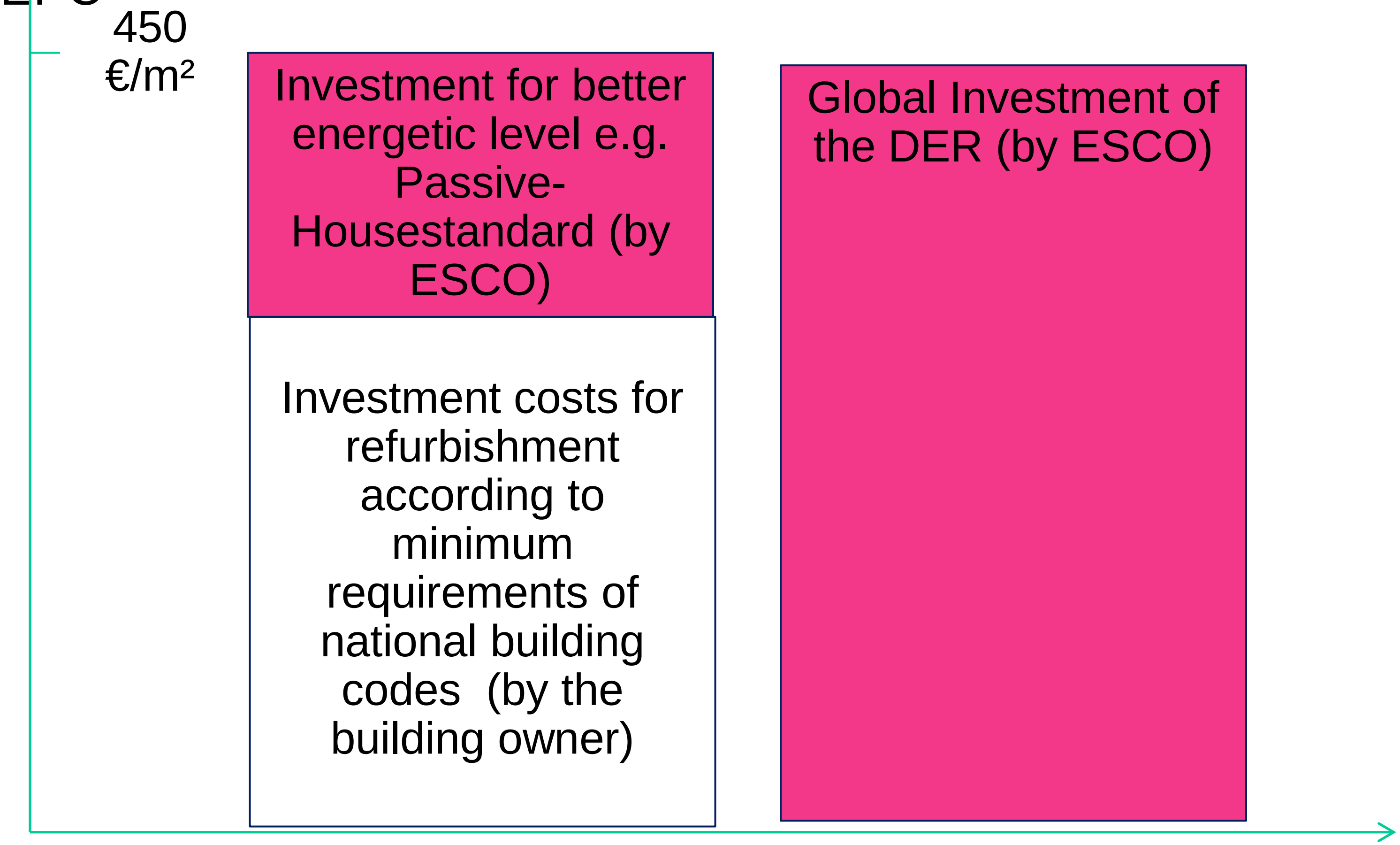
b) Depict life- cycle cash- flows accounting monetized benefits resulting from DER projects

Energy related benefits:
- E- consumption
- E- source modification

Non energy related savings:
- Maintenance costs
- Improved indoor climate
- Extended floor area
- Asset value

Scope of investments: global and energy better than minimum requirement

- 2 scopes of investments to be considerd for refinancing in an advanced EPC



Case study benefits/cash flows: Modeling Results for Office Building

224 kWh/m²yr H / 62 kWh/m²yr. E

Scenario	1:"base case"	2: new building adopted	3: - 50%	4: Passive House
Primary energy savings	34%	60%	54%	70%
a)Heating energy savings	33%	68%	60%	83%
b)incremental primary investment energy (€/m²)	200- 230	300- 330	280- 310	380- 430
bb) delta primary investment costs in comparison to scenario 1	-	100- 110	80- 100	180- 200
c)delta cost savings)in comparison to €/m²yr	-	10	7- 10	10- 14
bb/c	-	10	10-11	14-18

LCA- in advanced EPC

By accounting additional LC into an EPC financing scheme is contributing significantly to reduce the pay back period down to 20 and less years for a global DER investment

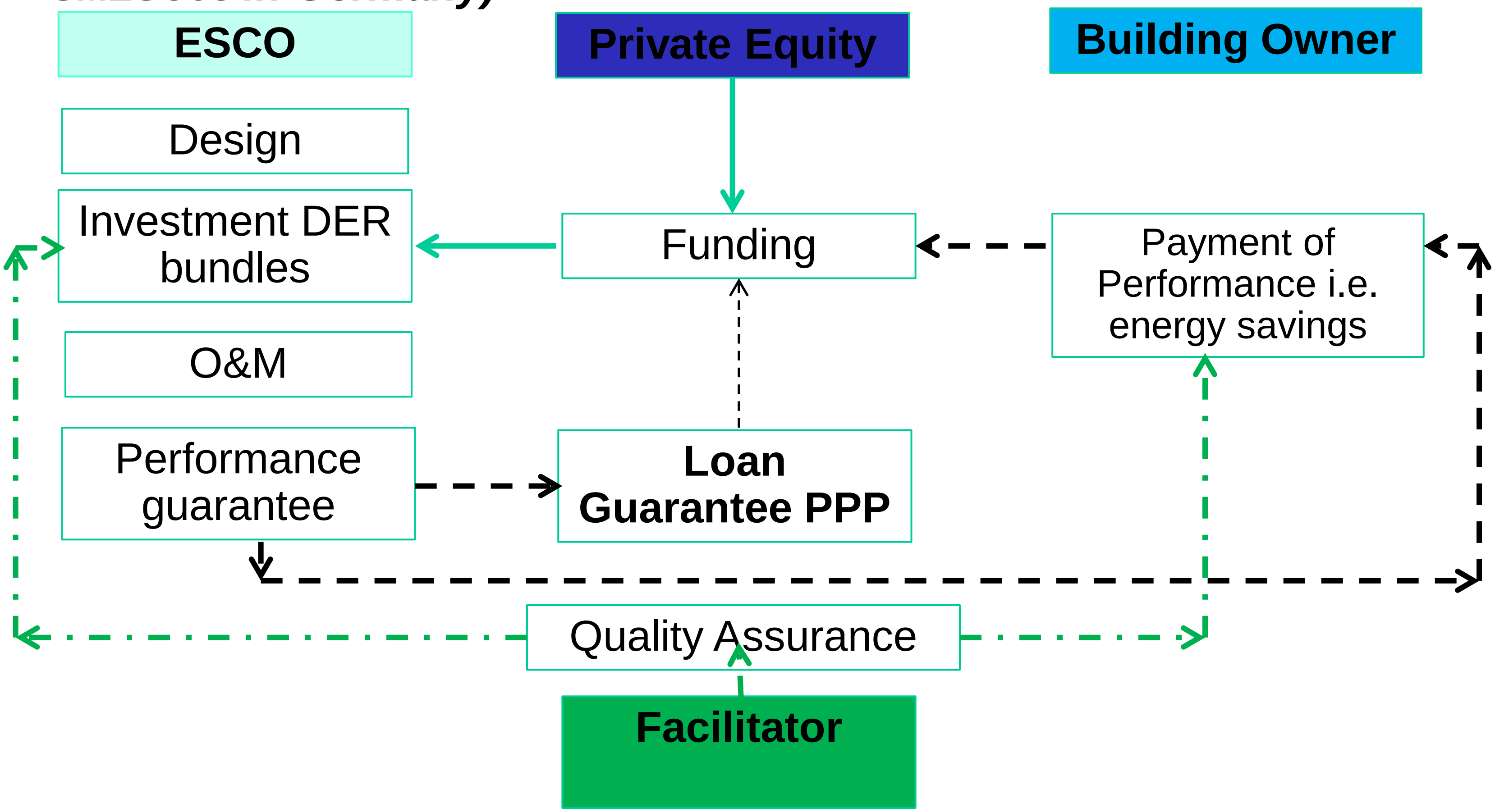
LC	mimimum (€/m²a)	Max (€/m²a)
Avoided maintenance and refurb- costs of replaced installation	2	4
Avoided replacement costs for existing installation	1 (HVAC)	6 (Facade)
Indoor air quality-productivity	0,8	4 (commercial bldg. BE)
Increased net floor area	0,5	2
Comparison: DER energy savings	**7**	**14**

Case studies for DER LCA

- **The approach is depending on :**
  - Technical equipment of the pre- refurbished building
  - Condition of building and equipment
  - Scope of DER measures and minimum requirements from national building codes concerning air exchange rates etc.
- **EU and US show different approaches**
  - Evaluation of existing equipment, value, function and condition e.g NEN 2767
  - Evaluation of indoor climate improvement e.g. Comfort- Meter Method (B), Croome assessment (UK)
- **EDLIG/Annex 61 continues collecting criteria and values for monetizing the non- energetic benefits of DER**

Development of advanced EPC

- **Develop of advanced business model** allocating investments and services between building owner and ESCos, development of financing mechanism by accounting and securing life- cycle costs and benefits ***(table shows new advanced business model for SMESCos in Germany)***

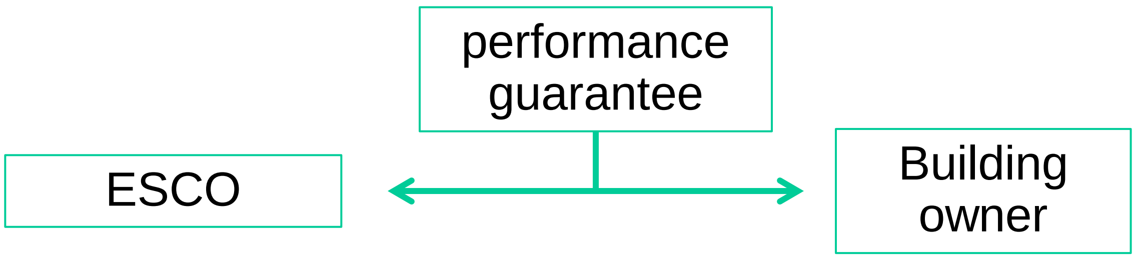


Development of advanced EPC

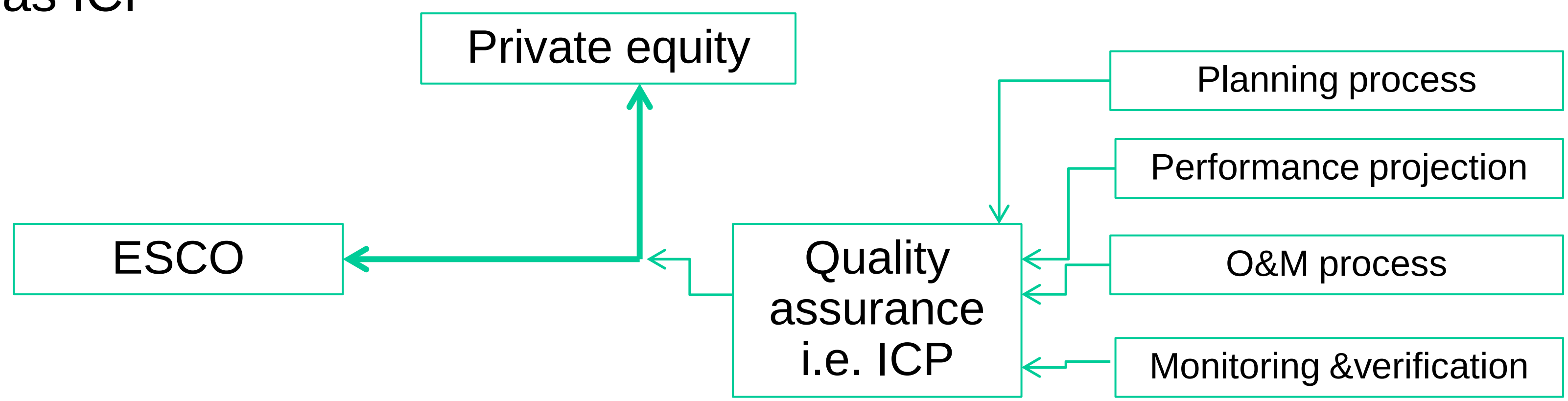
- Business model based on an EPC model:
    - How should the DER process look alike
    - Who should take which responsibility
    - Which guarantees for which performance
    - Short description
- Financial mechanism model
    - Definition of assurance process for financing between private equity and ESCOs at the hand of a simplified approach of ICP Europe (Dave Worthington/Frederic Brodach)
    - Definition of assurance process for saving guarantee for DER

Subtask B Strategy

- **Development of advanced financing mechanisms:**
- a) securing monetary streams between building owner and ESCO (performance guarantee with/without loan guarantee)



- b) securing third party investments by a quality assurance process such as ICP



Development of advanced EPC

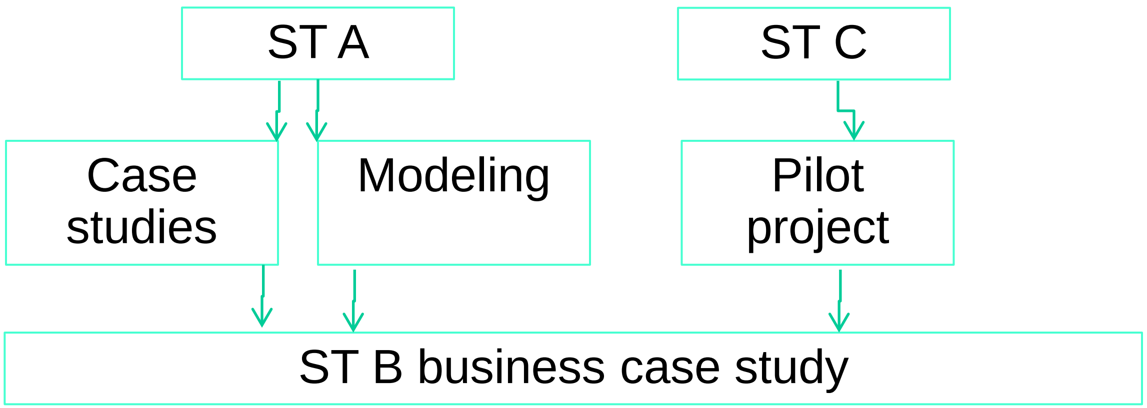
- **Development of advanced financing mechanisms – Reference to ST A:**

c) Setting up an inventory of accomplished and evaluated DER and other EE measures in buildings on EU and USA:

  - Comparison of ex ante / ex prediction/ ex post refurbishment energy consumption
  - Investment costs
  - Performance indexes (EUIs etc.)

- **Business Model Market application**:
- a) Analyze regulatory framework in the participating countries to determine barriers project implementation
- b) Engage with stakeholders (building owners and managers, financial community, and energy services companies) to develop improved business models corresponding to the environment in each country
- Investor´s Day

Development of advanced EPC



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A 61 – conclusions

Target: Business models based on (bankable) cash- flows- what we learned so far:

- Assessment of accomplished DER projects:
  - number and quality of collected projects is a good start to go but not sufficient to derive overarching strategies for the building stock
  - Data!? Availability of accurate experience records (performance and costs) lags

  VISION: Monitoring and Verification has to be mandatory in refurbishment of public building and subsidised refurbishment projects such as KfW
- DER bundles of standard measures can save 50- 89% heating energy
- The application of a DER bundle is not a guarantee for DER savings as user behaviour and needs have to be considered in the concept and the commissioning process
- Reliability of modeling may be kept in tolerable boundaries if the model is adjusted accurately
- To increase the attractiveness of DER additional non- energy related benefits have to be considered
- Involving non- energetic benefits by monetizing them into the account of a DER business model will create pay back periods and NPV attractive for private funding

Vielen Dank! Thank you

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