PROFITABILITY OF ACTIVE RETROFITTING IN MULTI-APARTMENT BUILDINGS – A SPECIAL FOCUS ON PV AND DIFFERENT HEATING SYSTEMS

ENERDAY 2019

Presenter: Bernadette Fina

Affiliation: AIT Austrian Institute of Technology

Energy Economics Group (EEG), TU Wien

MOTIVATION

- 40 % of the total energy consumption and…
- 36 % of the CO_2 emissions in the EU are caused by the building sector

Furthermore

- 35 % of the European building stock is older than 50 years, and thereof…
- 75 % are energy inefficient

→ **Retrofitting of the old housing stock is highly necessary!**

- 50 % of the European buildings are multi-apartment buildings → addressing this building segment most important

MODEL AND METHOD

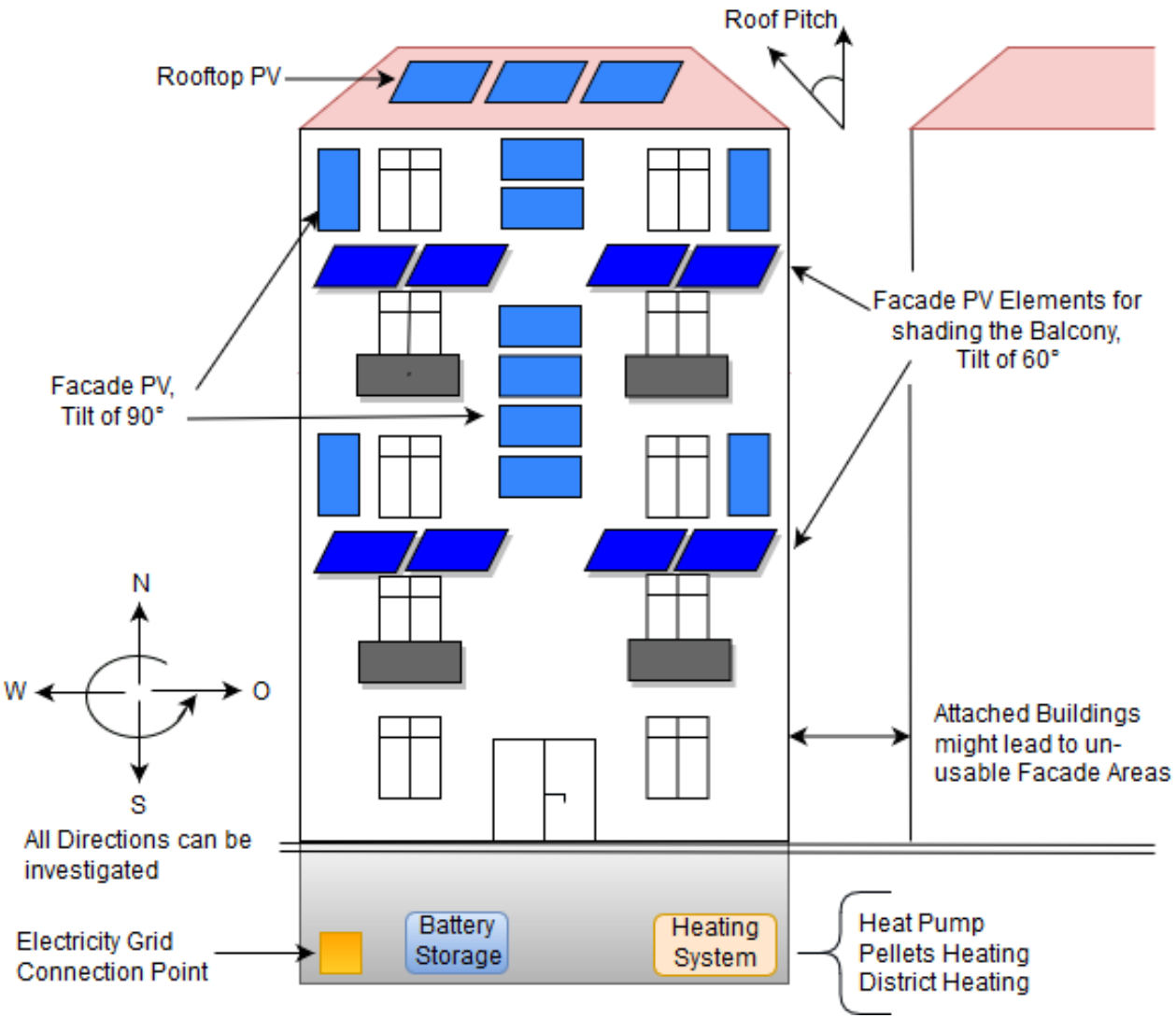
- Mixed-integer linear optimisation model is developed
- Objective Function: Maximising the Net Present Value (NPV)
- Major Outputs of the Model:

  → Net Present Value
  → Profitability of active retrofitting measures
  → According optimal system capacities

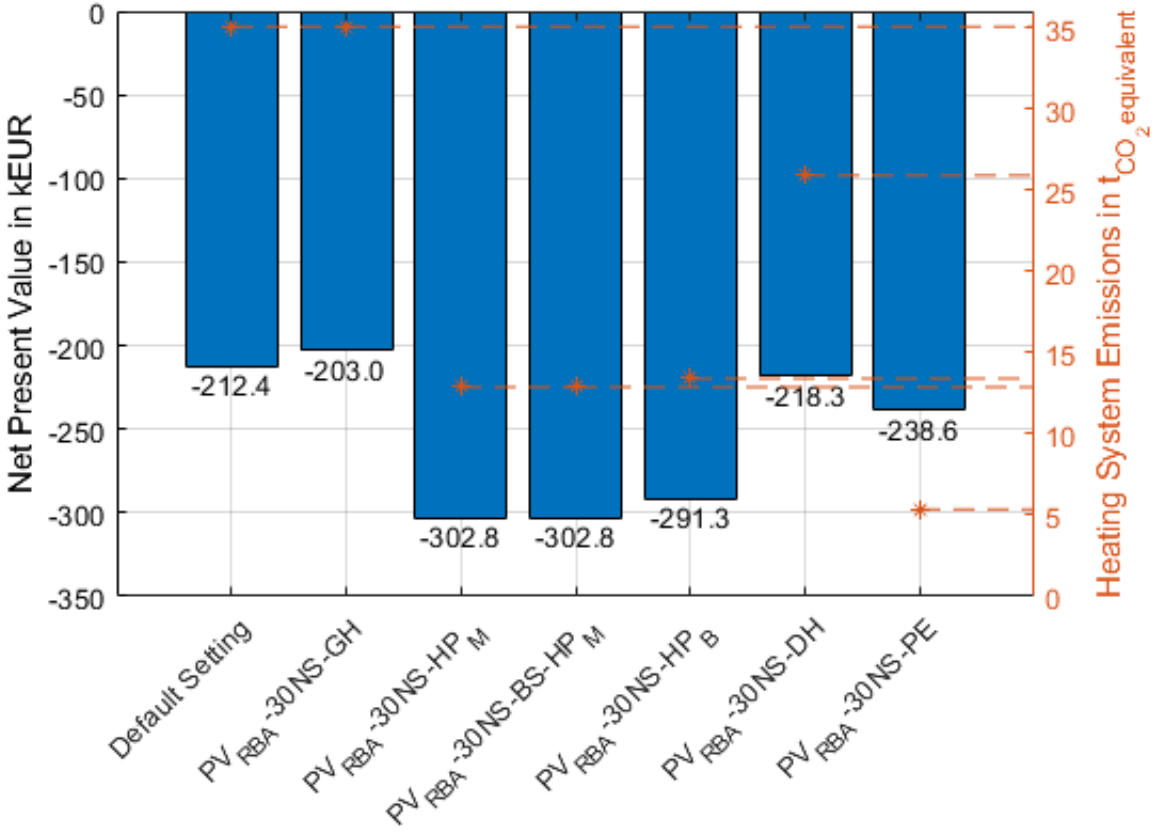
For more detailed information concerning the model and the results which are presented in the following please see:

Fina B., Auer H., Friedl W., 2019. Profitability of active retrofitting of multi-apartment buildings: Building-attached/integrated photovoltaics with special consideration of different heating systems. Energy and Buildings 190, 86-102. https://doi.org/10.1016/j.enbuild.2019.02.034

BUILDING SET-UP AND ACTIVE RETROFITTING MEASURES



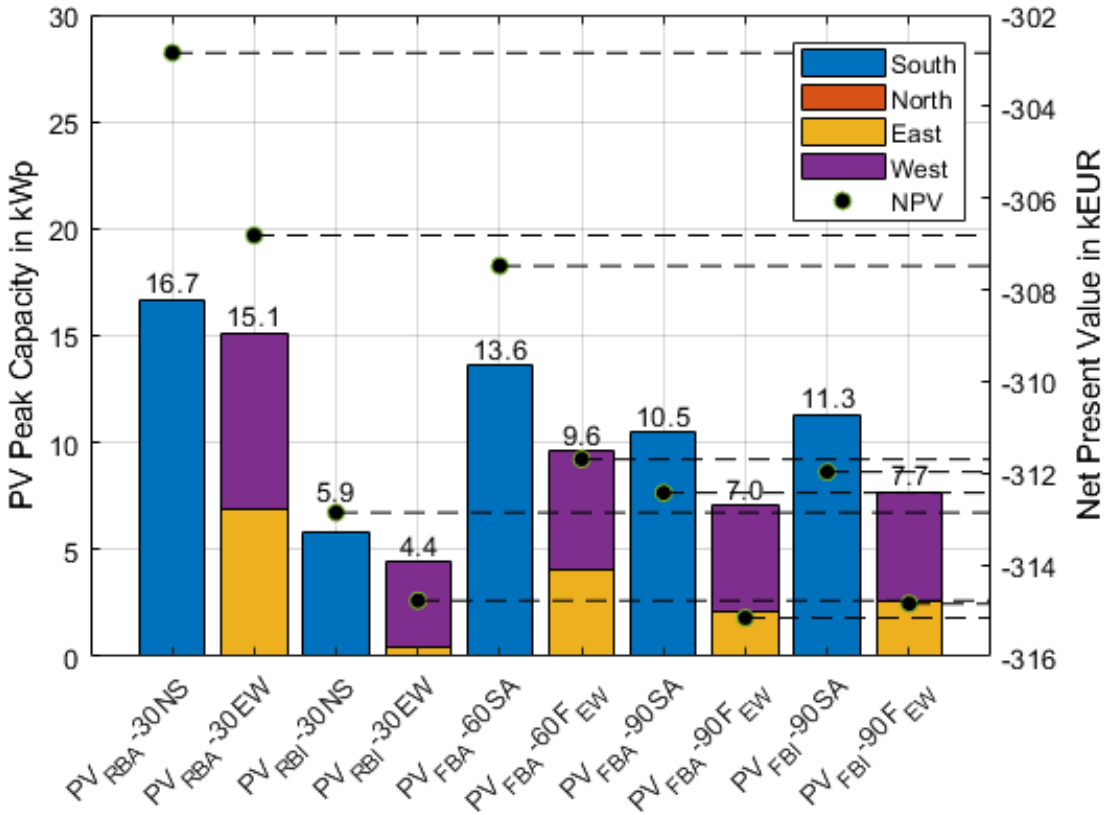
RESULTS – HEATING SYSTEM CHANGE



Default Setting:

- 145kWh/m²a heat load
- Gas heating
- Stand-alone building
- 30° roof pitch

RESULTS – DIFFERENT PV SYSTEMS



- Building-attached rooftop PV most profitable
- Building-integrated PV also profitable despite additional basic retro-fitting costs
- Northern part of the roof not used for PV implementation → not profitable

IMPACT OF BUSINESSES ON THE PROFITABILITY OF PV

- Characteristics:

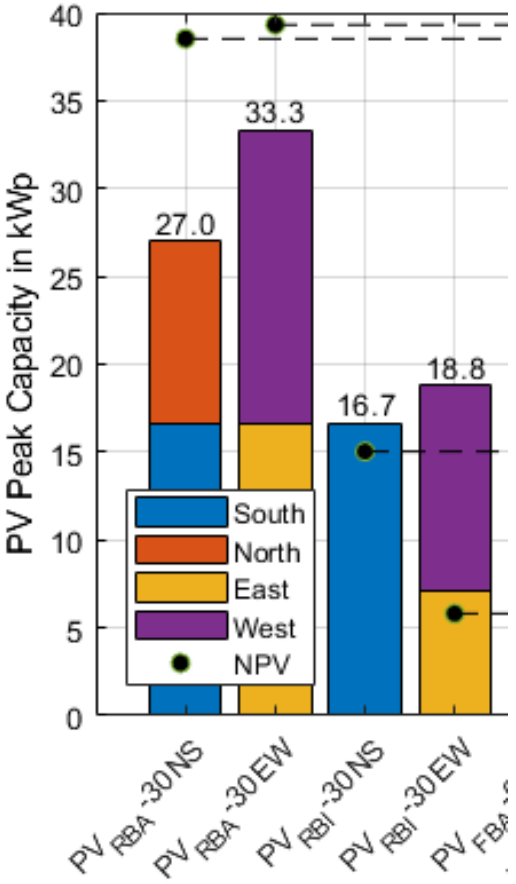
  → Good correlation to sunshine hours
  → Most energy consumption during the day

- Impact:

  → Optimal PV installation capacities rise

  → Profitability of PV increases

  → Northern part of the roof is used for PV implementation: Profitability despite weaker solar irradiation



IMPACT OF INCREASING THE BUILDING STANDARD

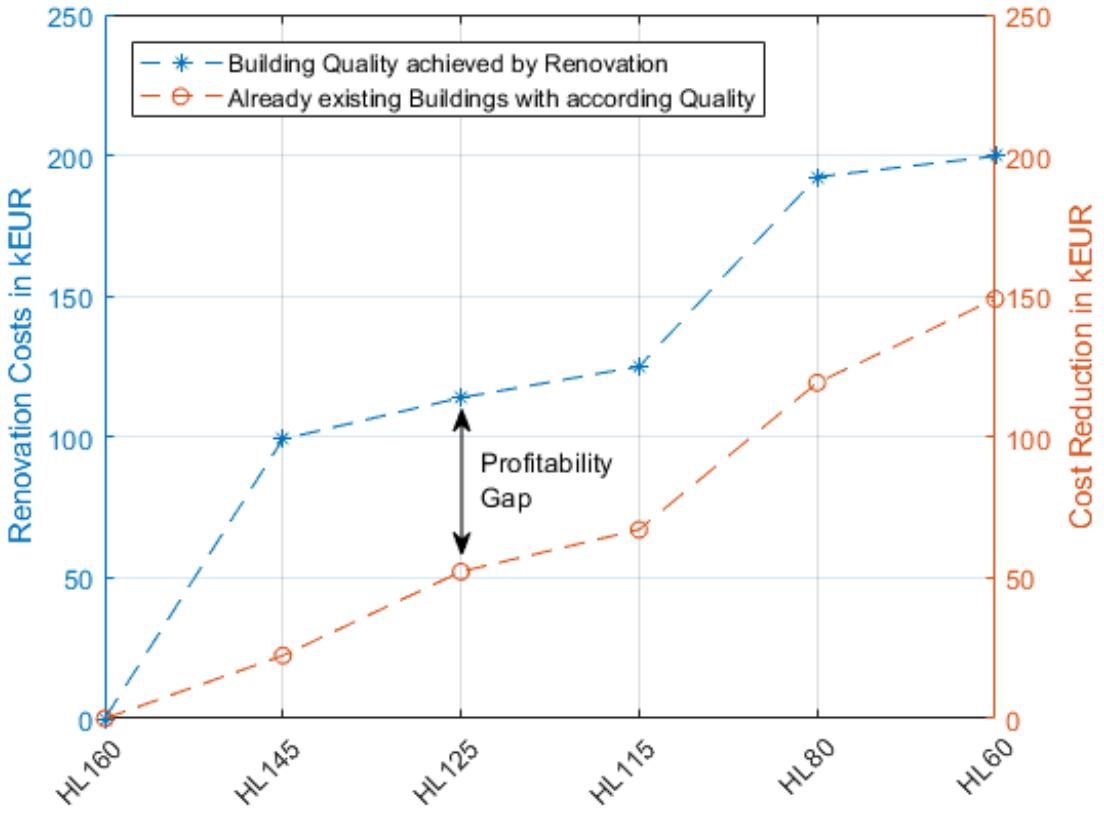
<u>In blue:</u>

Retrofitting costs, which occur when improving the building standard (passive renovation)

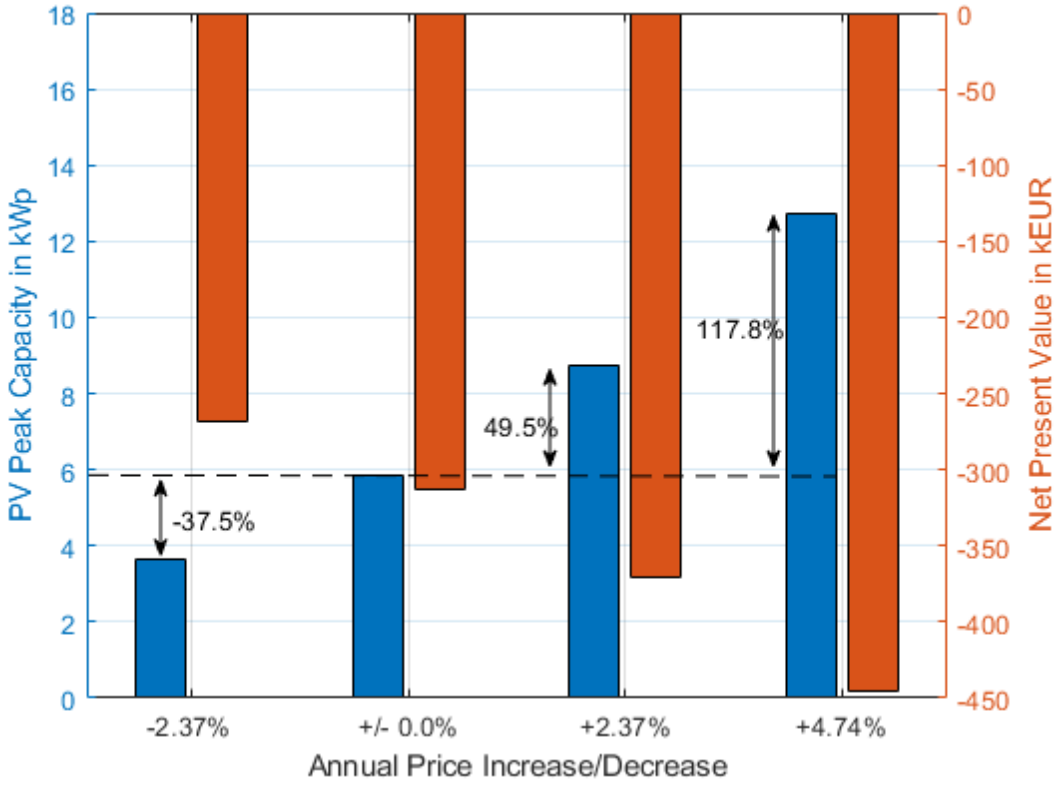
versus

<u>In red:</u>

Monetary value of energy savings achieved by better building standard



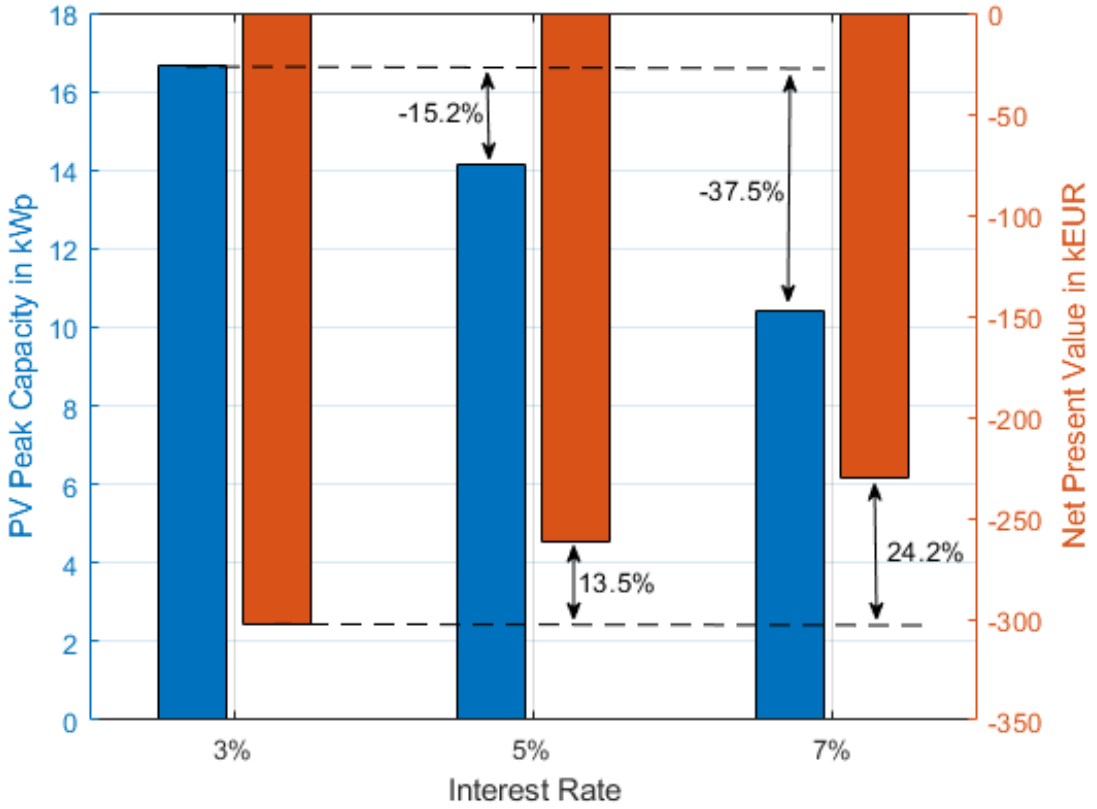
IMPACT OF RETAIL ELECTRICITY PRICE VARIATIONS



- Within the past ten years: annual retail electricity price increase by 2.37% in Europe (linear assumption)
- Rising retail electricity price leads to:

  → Increasing optimal PV sytem capacities
  → Decreasing NPV
- Cost saving potential of PV systems rises

IMPACT OF INTEREST RATES



- Rising interest rates lead to:

  → Decreasing optimal PV system sizes
  → Increasing NPV

- Future cash flows are reduced by increasing interest rates:

  → Decreasing cost saving potential of PV systems
  → But also: Decreasing influence of future payments for electricity and heat

CONCLUSION

- Building-attached and building-integrated PV achieve break-even
- Heating systems like heat pumps, pellets and district heat not competitive with conventional gas
- Profitability of PV strongly depends on retail electricity price development and expectations of the rate of return
- Sustainable building retrofitting contains a combination of active and passive retrofitting measures
- Profitability gap can be addressed by:

  → Governmental incentives like subsidies
  → True cost pricing of CO_2 emissions

THANK YOU!

Presenter: Bernadette Fina

Affiliation: AIT Austrian Institute of Technology GmbH
Energy Economics Group (EEG), TU Wien

Email: bernadette.fina@ait.ac.at