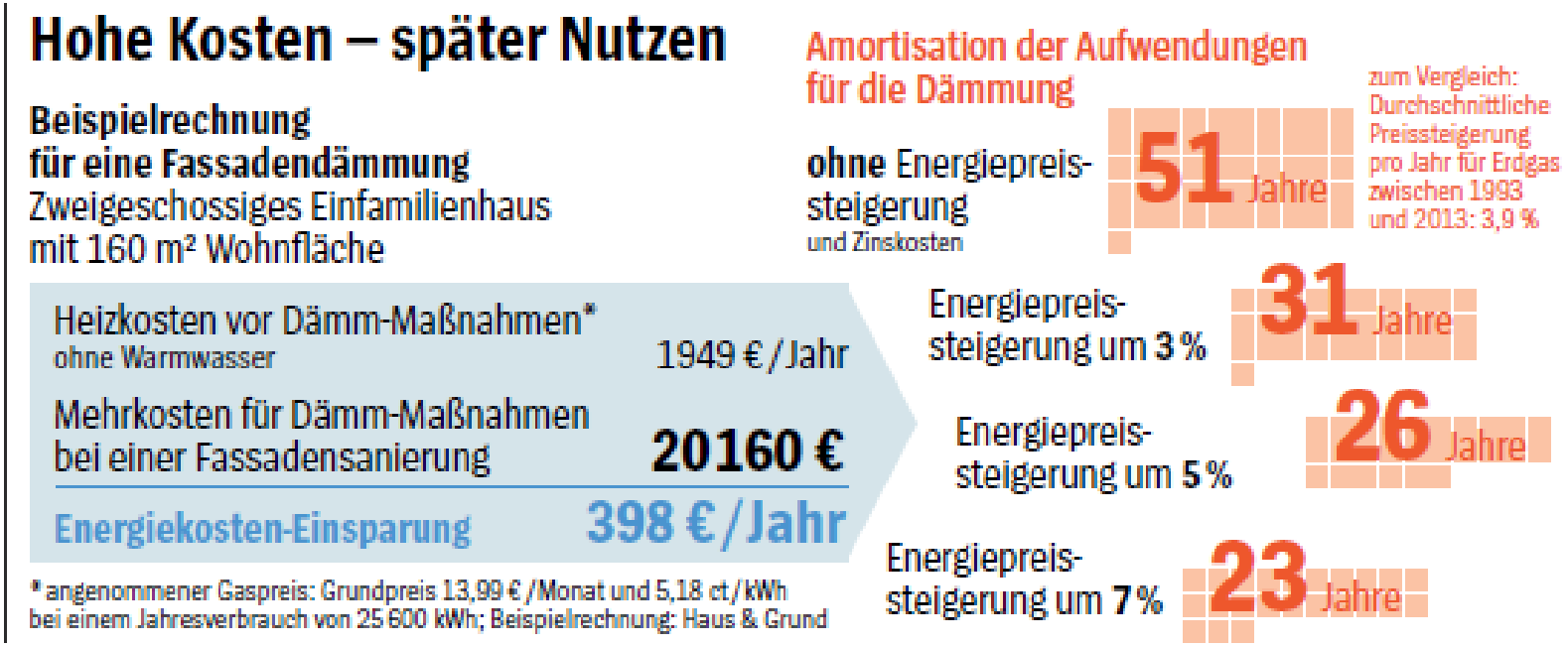
Economic efficiency of thermal insulation aimed at saving energy

a critical assessment

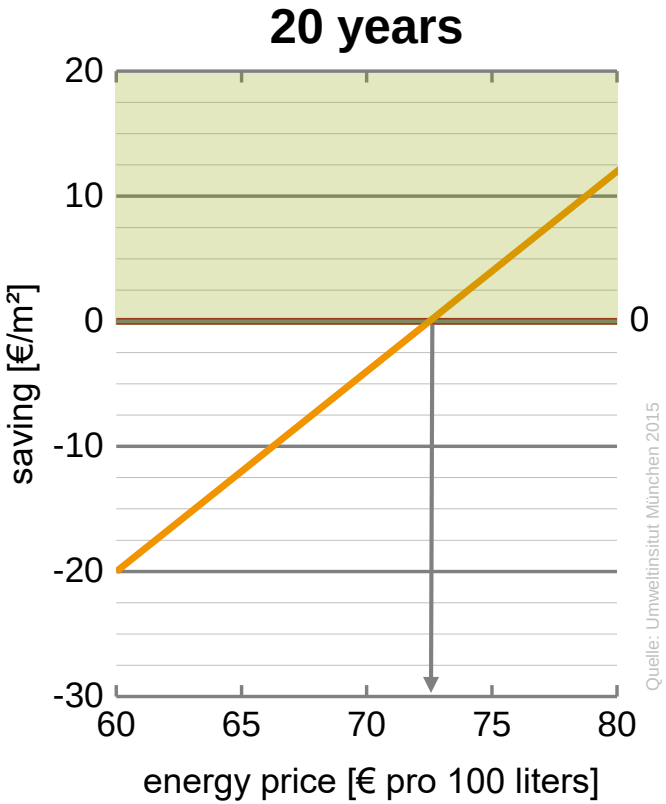

DIE ZEIT
SPIEGEL
Stuae
DIE WEL
Frankfurter Allgem
ZEITUNG FÜR DEUTSC
Handelsblat

http://www.detail.de/uploads/pics/Forschungsprojekt_zum_WDVS_Recycling_01_A_01.jpg

… return of investment

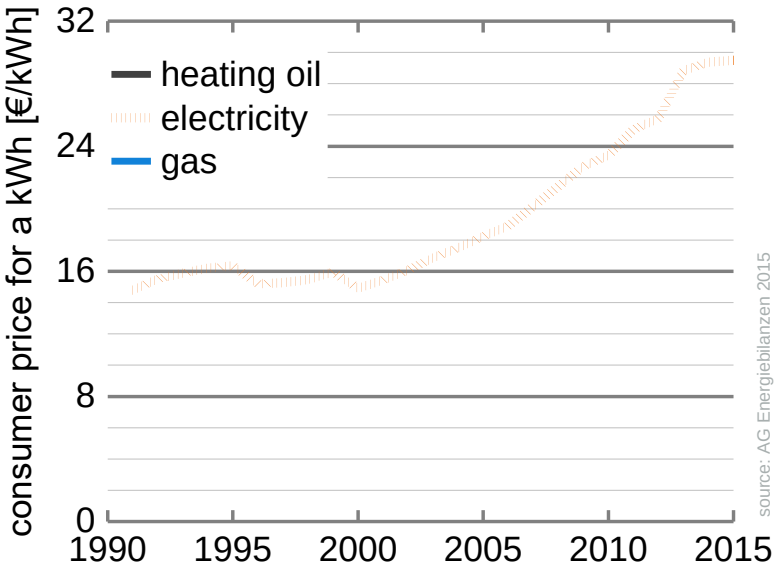


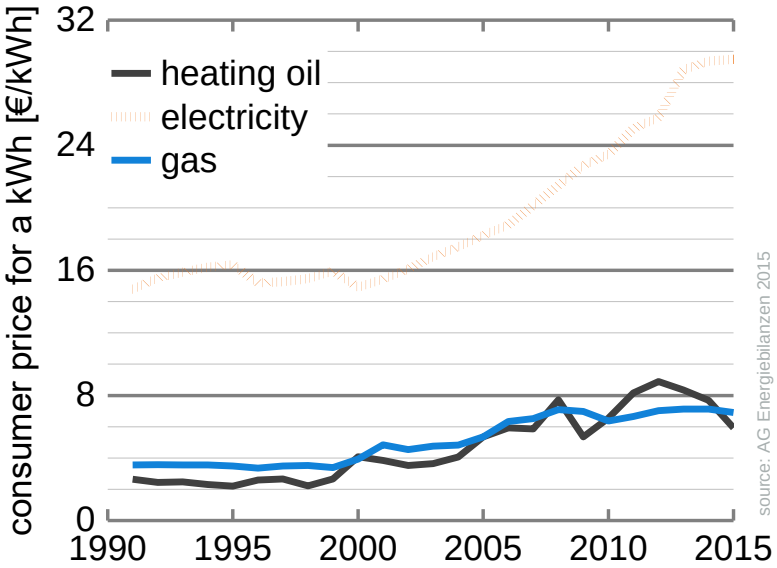
Quelle: Spiegel 49/2014



Annahmen:
Gesamtkosten 150 €/m², davon Sowieso-Kosten: 50 €/m²
U-Wert vor der Dämmung: 1,0 W/(m²K)

Preissteigerung: ? - Realzins: ?


consumer price for a kWh [€/kWh]
32
24
16
8
0
heating oil
electricity
gas
1990
1995
2000
2005
2010
2015
source: AG Energiebilanzen 2015

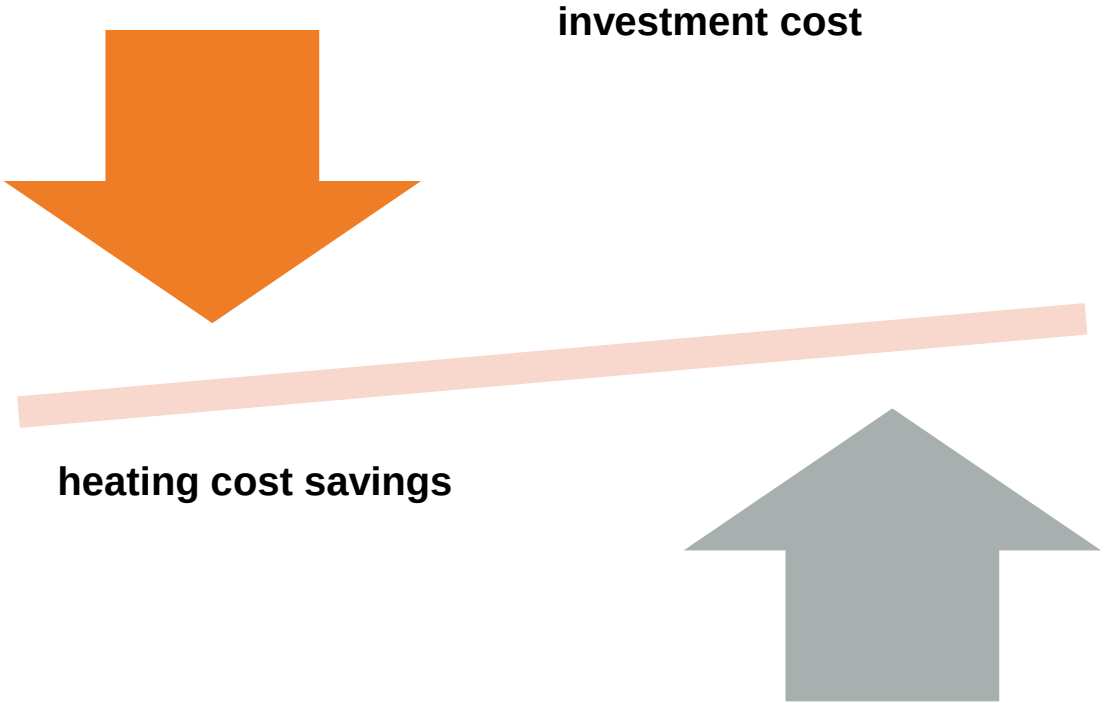

consumer price for a kWh [€/kWh]
32
24
16
8
0
heating oil
electricity
gas
1990
1995
2000
2005
2010
2015
source: AG Energiebilanzen 2015

http://www.schule.rorschach.ch/potatoe/5FR007/zahlengitter.jpg

http://blog.seitwert.de

background

influencing factors

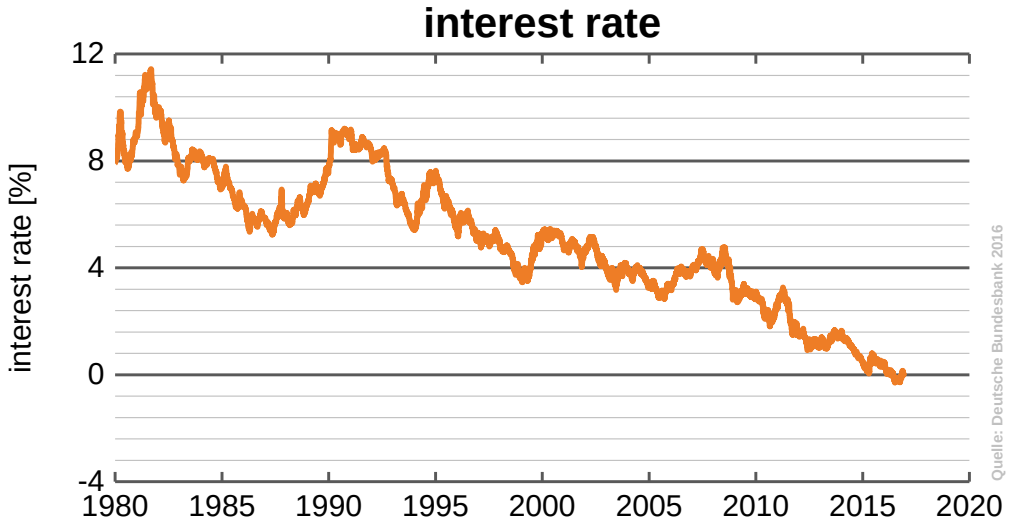


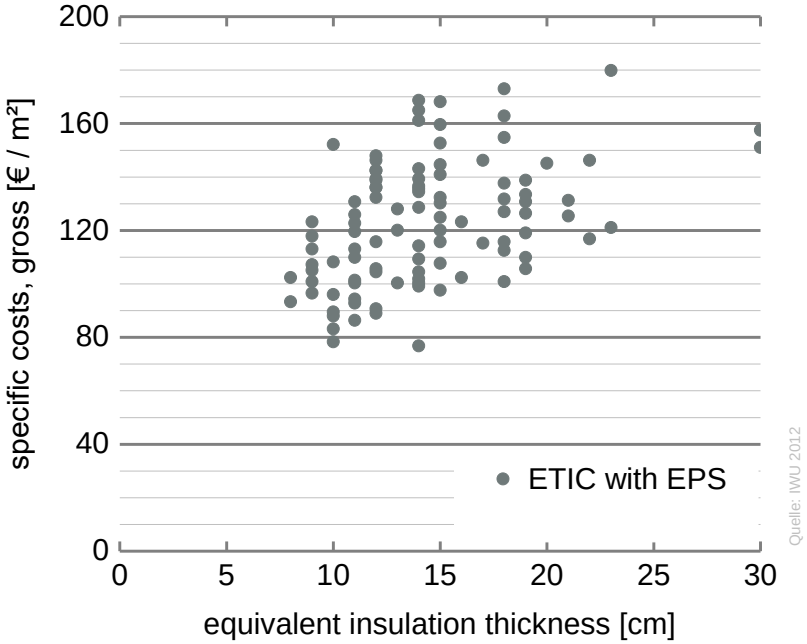
additional cost-benefit ratio (MNV)

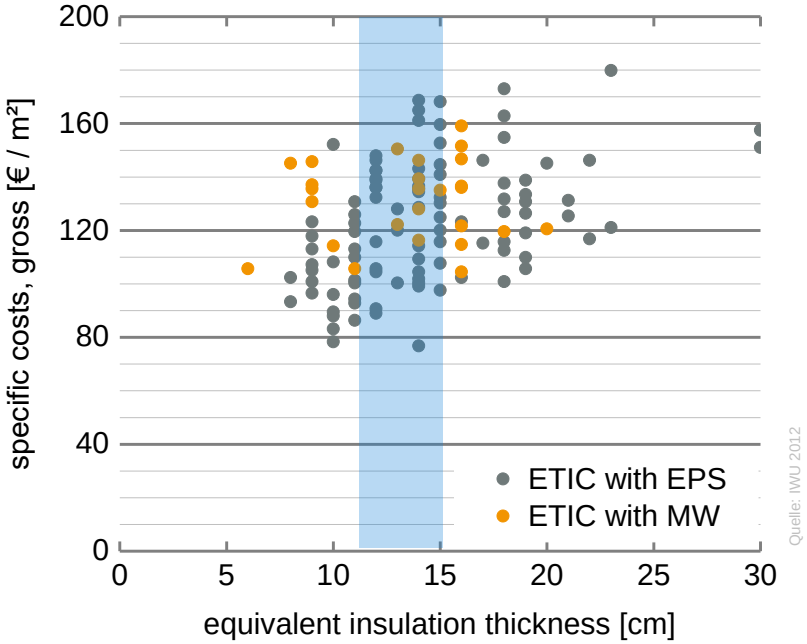
$$MNV = \frac{\text{additional costs } [€/m^2]}{\text{energy saving } [\frac{kWh}{m^2 a}]}$$

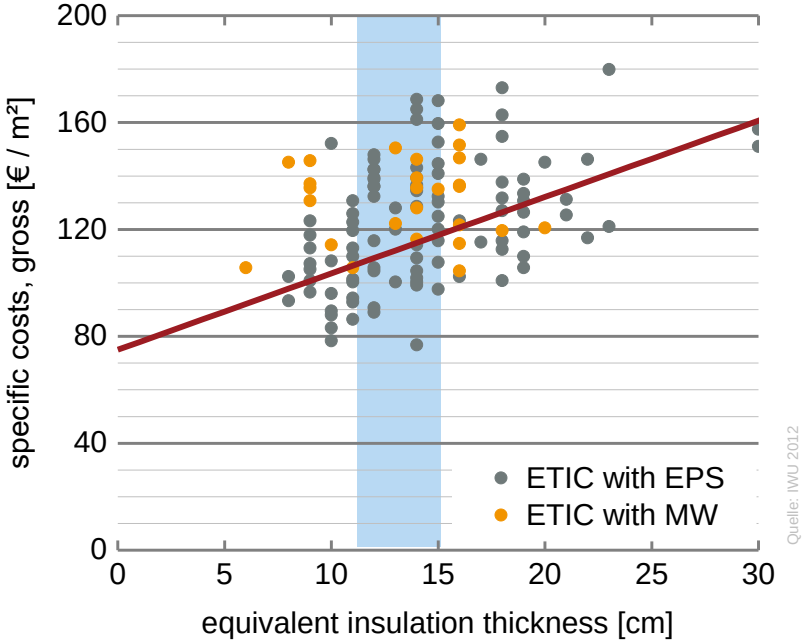
low MNV = better economical benefit

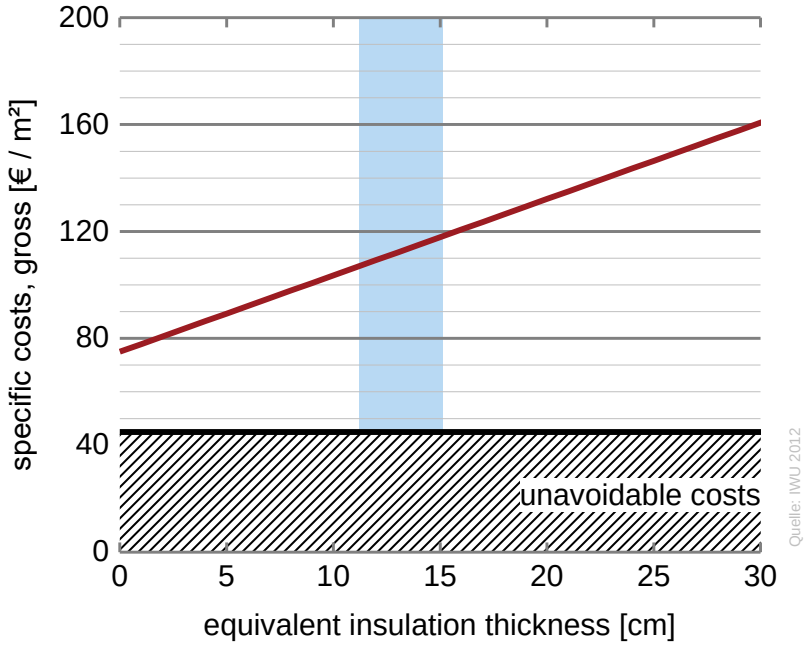
Investment costs

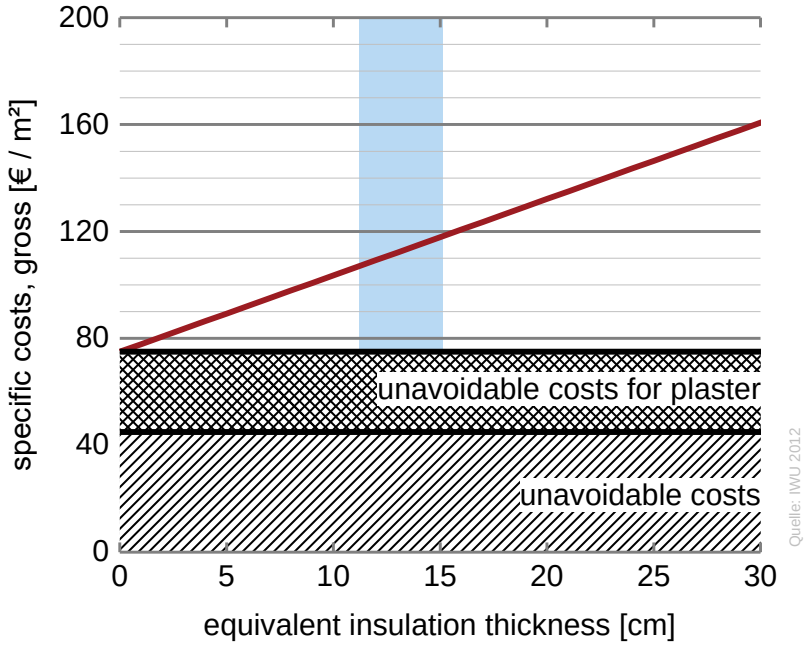

interest rate
interest rate [%]
12
8
4
0
-4
1980
1985
1990
1995
2000
2005
2010
2015
2020
Quelle: Deutsche Bundesbank 2016

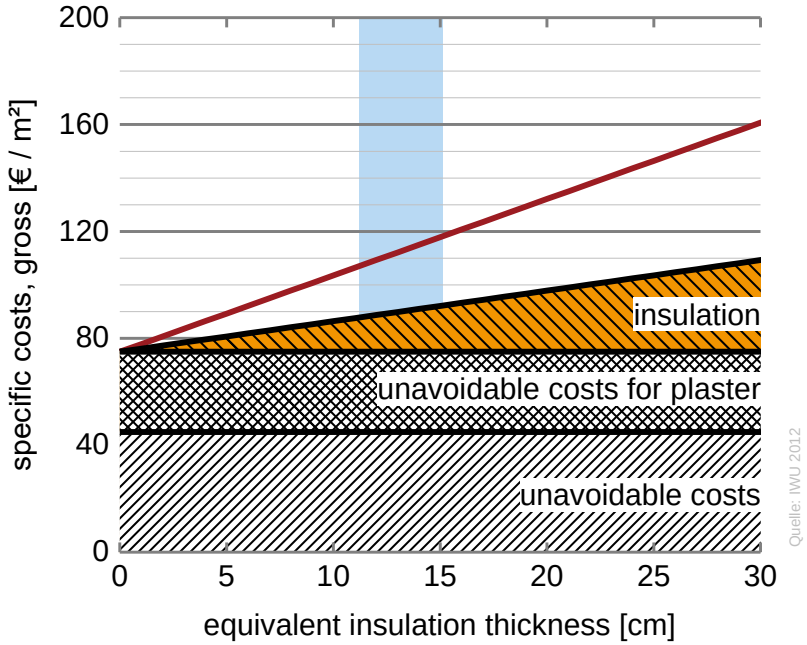

200
160
120
80
40
0
specific costs, gross [€ / m²]
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
ETIC with EPS
Quelle: IWU 2012

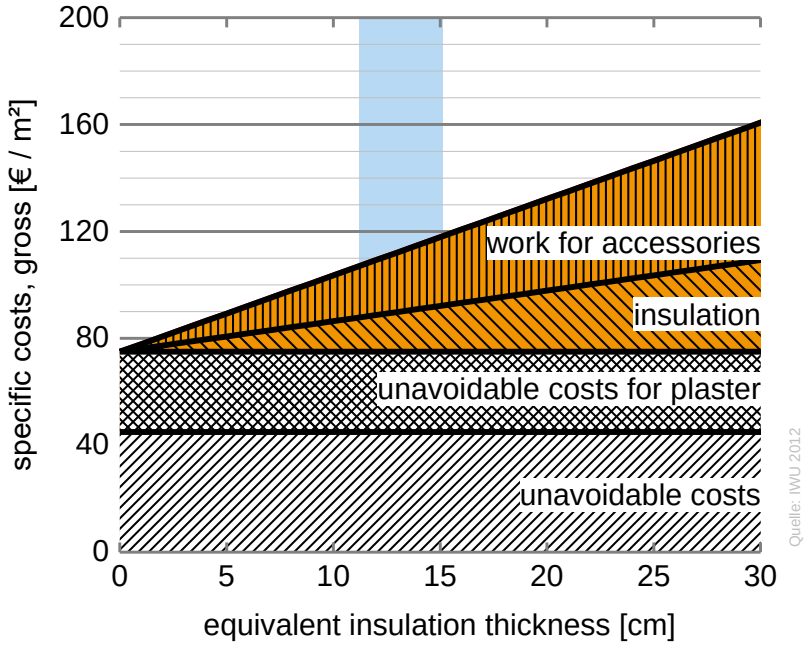

specific costs, gross [€ / m²]
200
160
120
80
40
0
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
ETIC with EPS
ETIC with MW
Quelle: IWU 2012

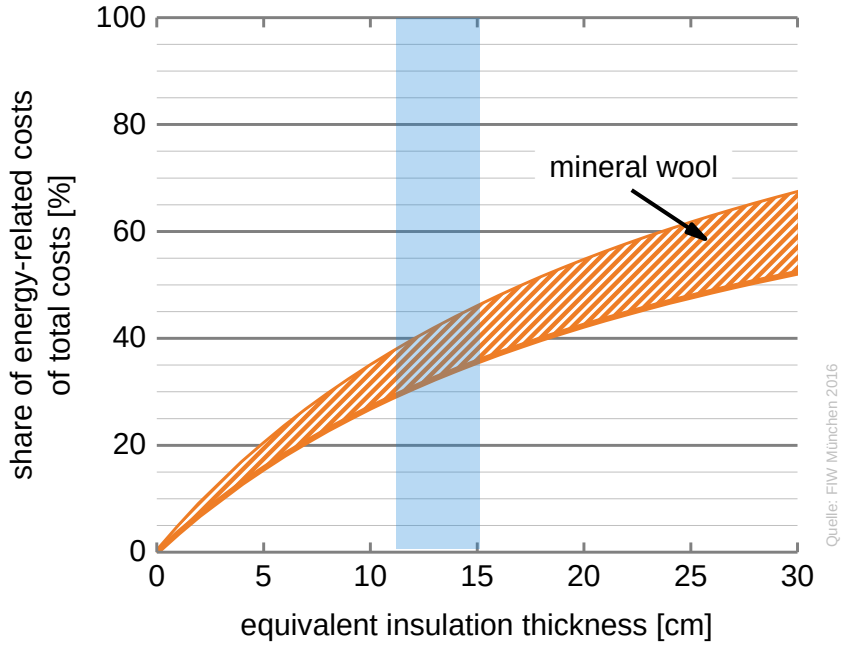

200
160
120
80
40
0
0
5
10
15
20
25
30
specific costs, gross [€ / m²]
equivalent insulation thickness [cm]
ETIC with EPS
ETIC with MW
Quelle: IWU 2012

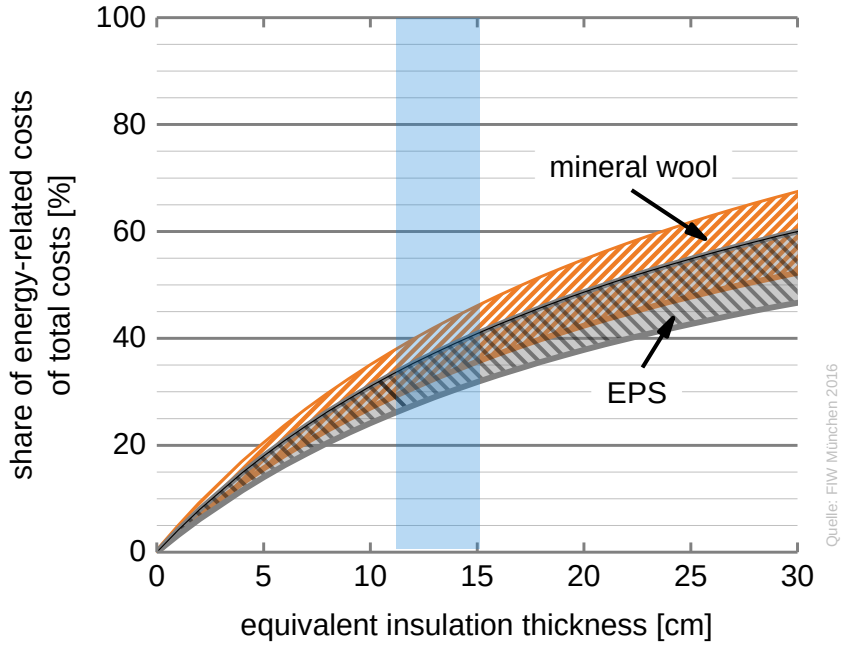

200
160
120
80
40
0
specific costs, gross [€ / m²]
unavoidable costs
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
Quelle: IWU 2012


200
160
120
80
40
0
specific costs, gross [€ / m²]
unavoidable costs for plaster
unavoidable costs
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
Quelle: IWU 2012


200
160
120
80
40
0
specific costs, gross [€ / m²]
insulation
unavoidable costs for plaster
unavoidable costs
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
Quelle: IWU 2012


200
160
120
80
40
0
specific costs, gross [€ / m²]
work for accessories
insulation
unavoidable costs for plaster
unavoidable costs
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
Quelle: IWU 2012


100
80
60
40
20
0
share of energy-related costs
of total costs [%]
mineral wool
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
Quelle: FIW München 2016


share of energy-related costs
of total costs [%]
100
80
60
40
20
0
0
5
10
15
20
25
30
equivalent insulation thickness [cm]
mineral wool
EPS
Quelle: FIW München 2016

additional cost-benefit ratio (MNV)

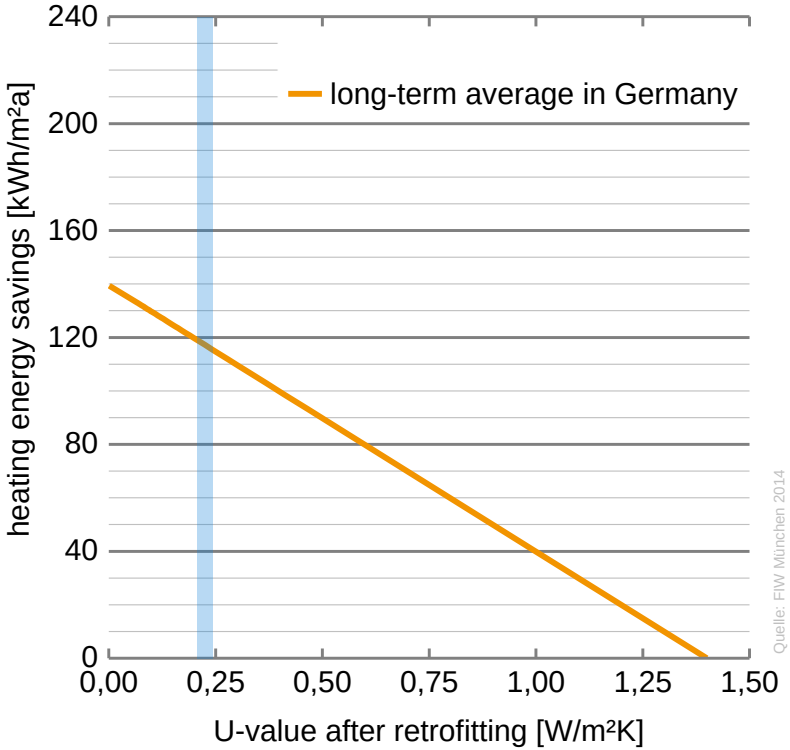
$$MNV = \frac{\text{additional costs } [€/m^2]}{\text{energy saving } [\frac{kWh}{m^2 a}]}$$

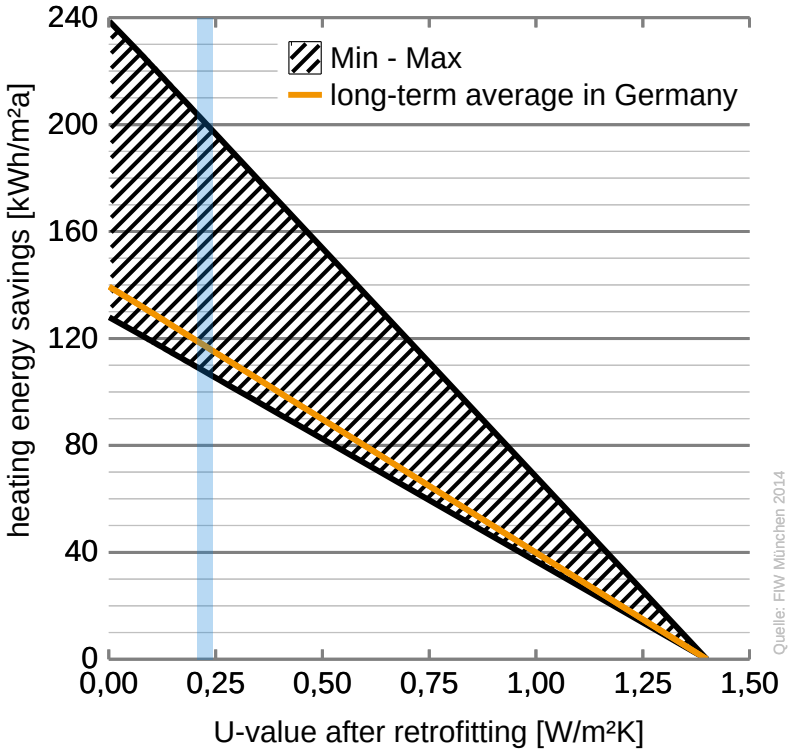
low MNV = better economical benefit

additional cost-benefit ratio (MNV)

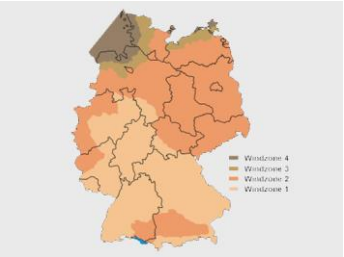
Heating energy saving

- U-value of the existing construction
- Location (Climate)
- Weather
- Heating behavior


240
200
160
120
80
40
0
heating energy savings [kWh/m²a]
long-term average in Germany
0,00
0,25
0,50
0,75
1,00
1,25
1,50
U-value after retrofitting [W/m²K]
Quelle: FIW München 2014



Quelle: FIW München 2014



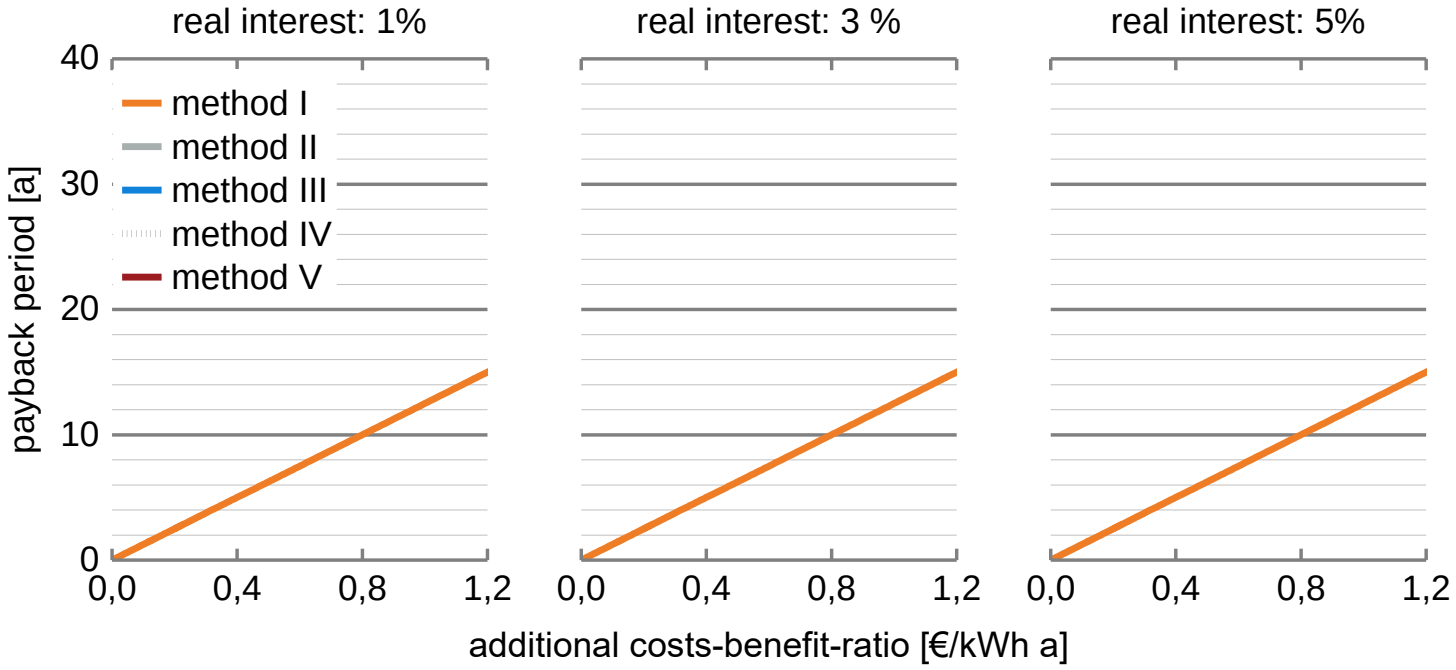
additional cost-benefit ratio (MNV): 0,4 … 0,6

http://www.detail.de/uploads/pics/Forschungsprojekt_zum_WDVS_Recycling_01_A_01.jpg

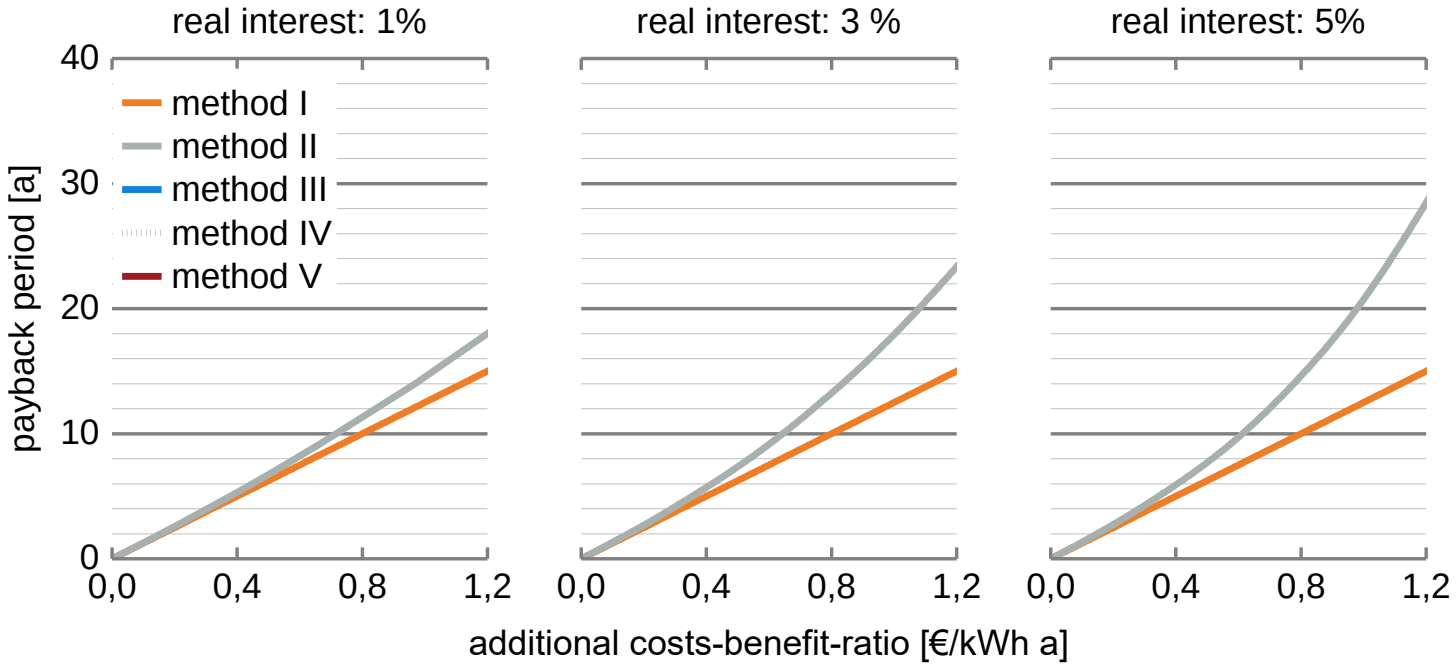
calculation methods

- Static amortization (simple amortization)
- Dynamic amortization without changes in energy prices
- Dynamic amortization with changes in energy prices
- Net present value and annuity
- Internal rate of return

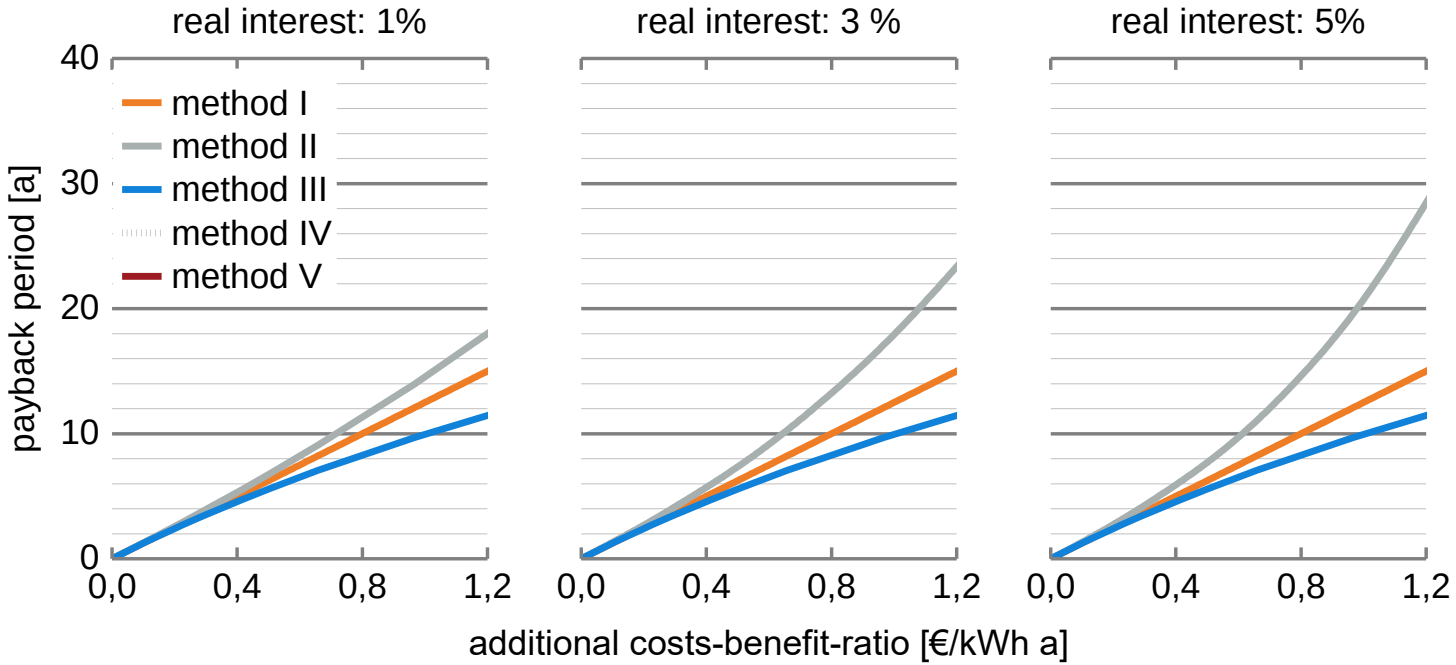
static amortization (simple amortization)



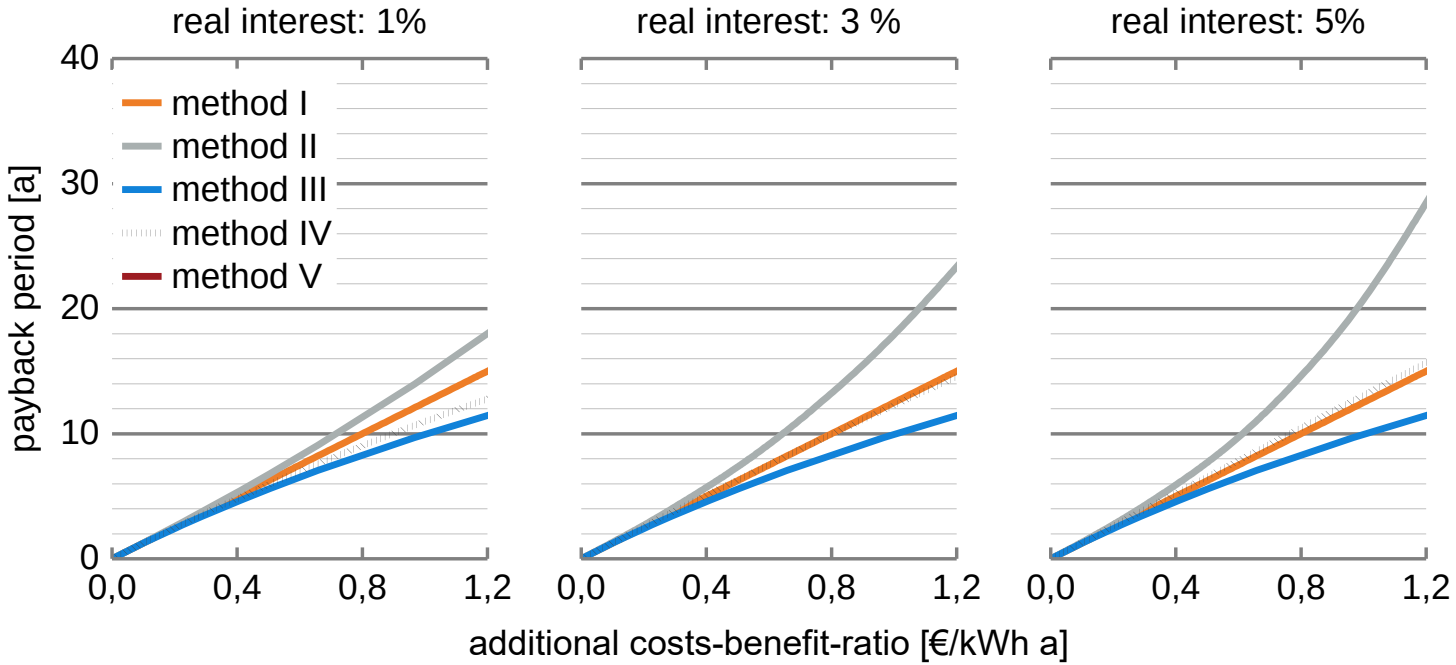
dynamic amortization w/o changes in energy prices



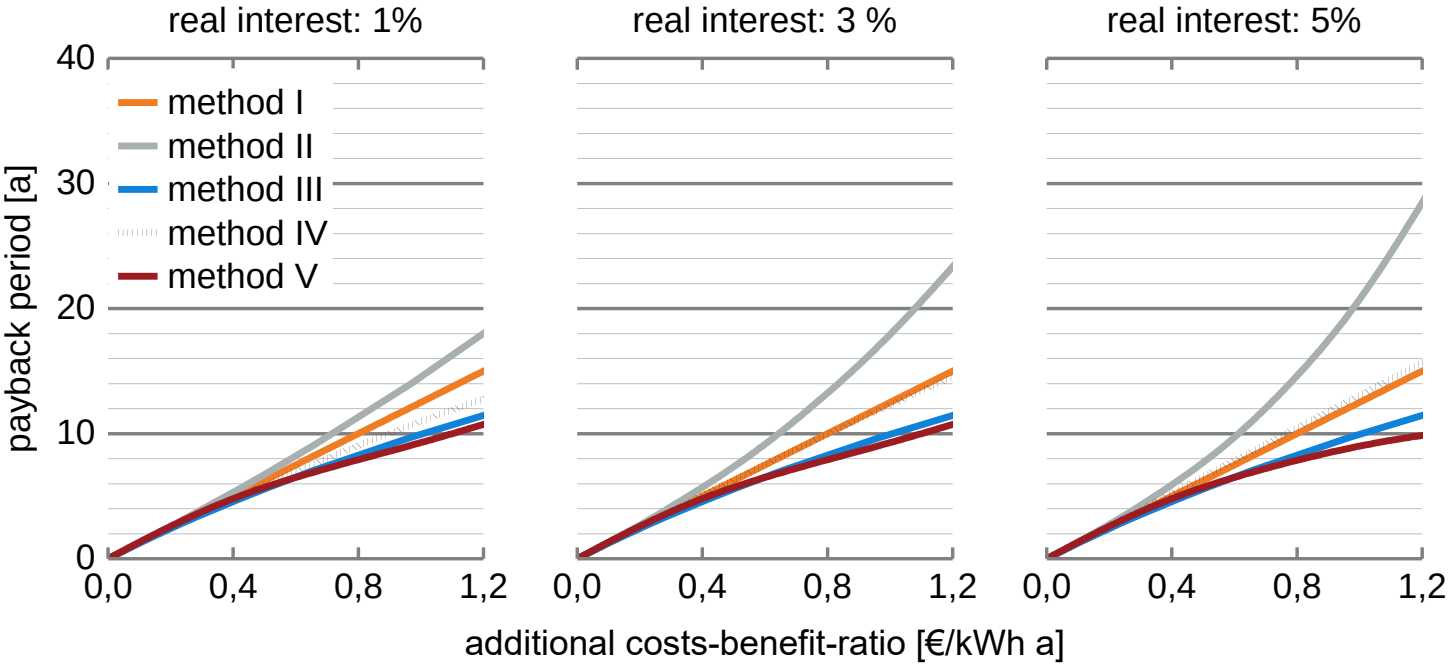
dynamic amortization w changes in energy prices



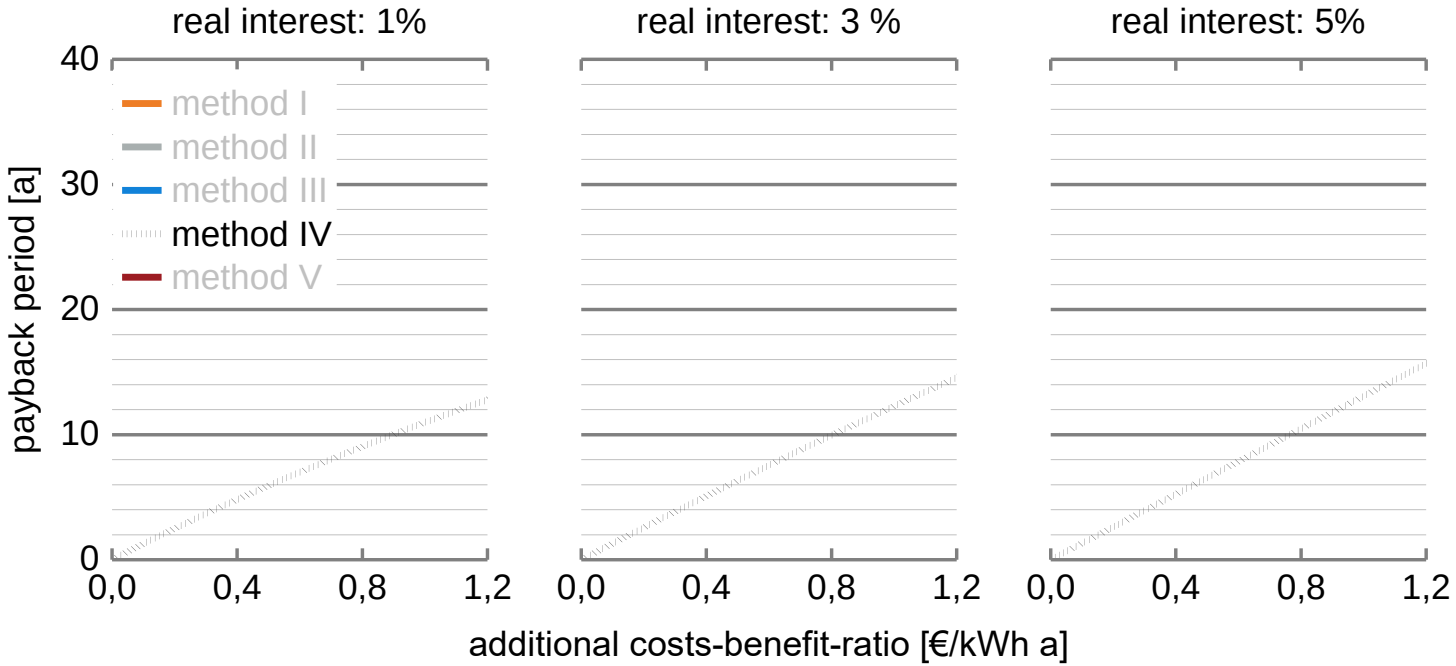
net present value and annuity



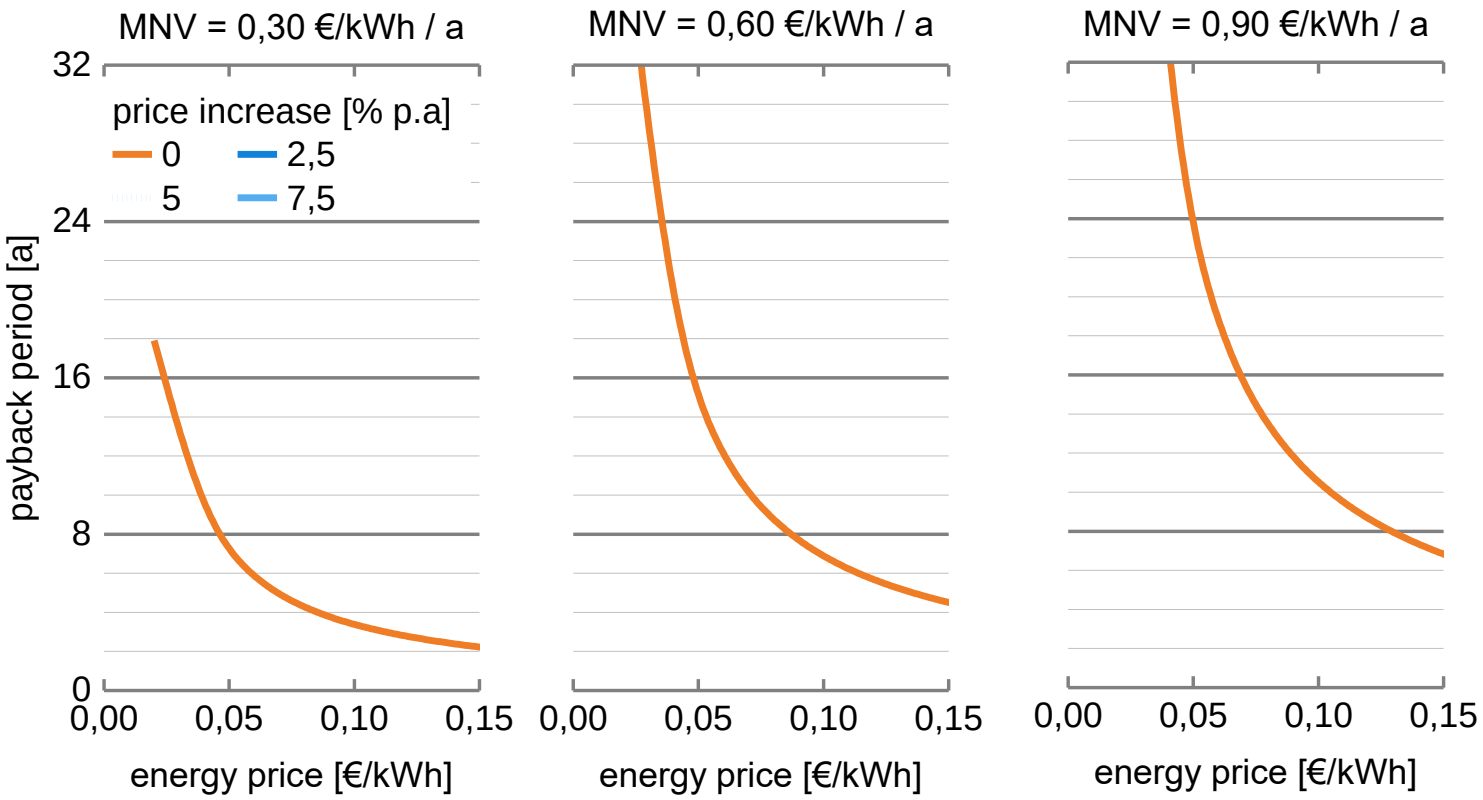
internal rate of return

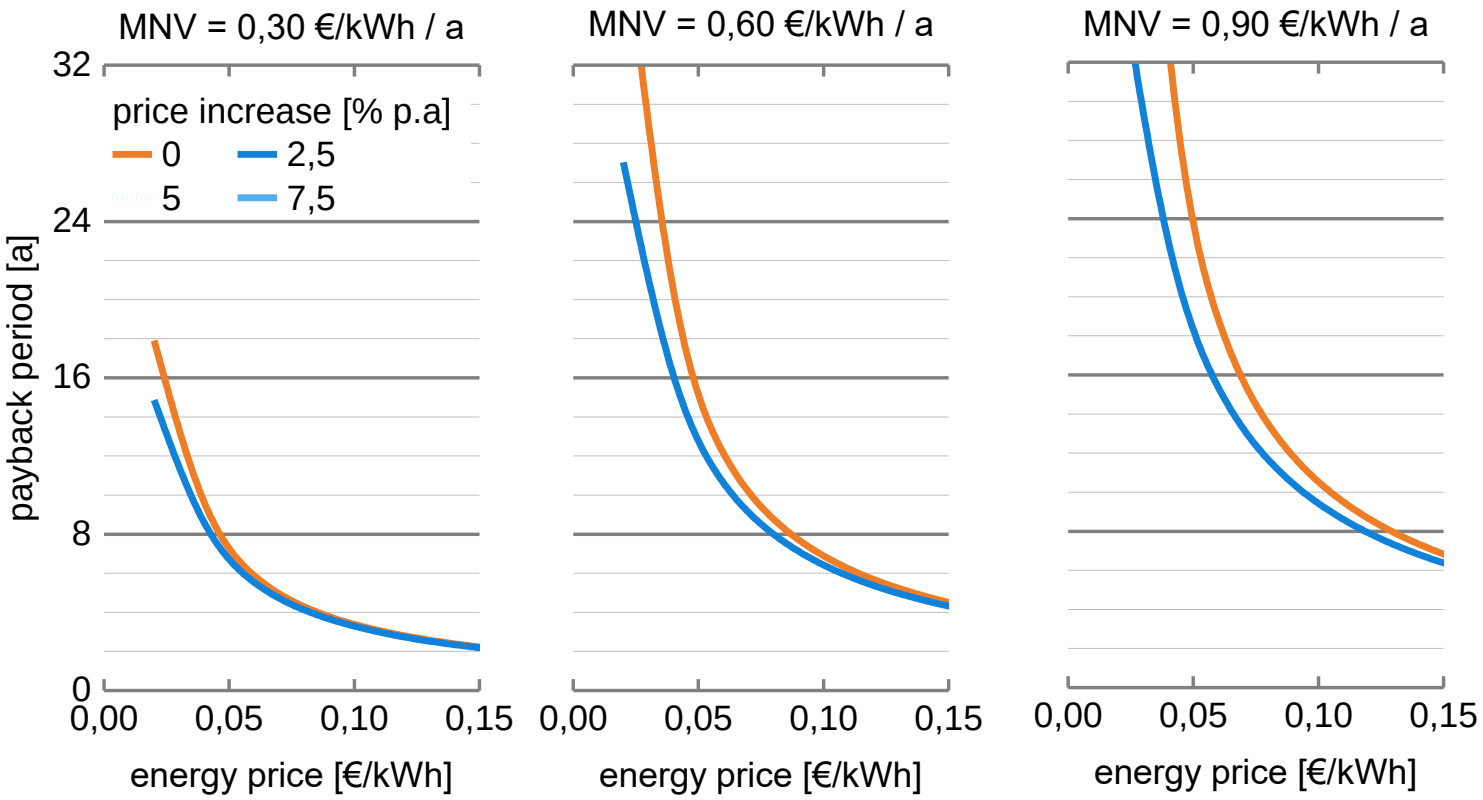


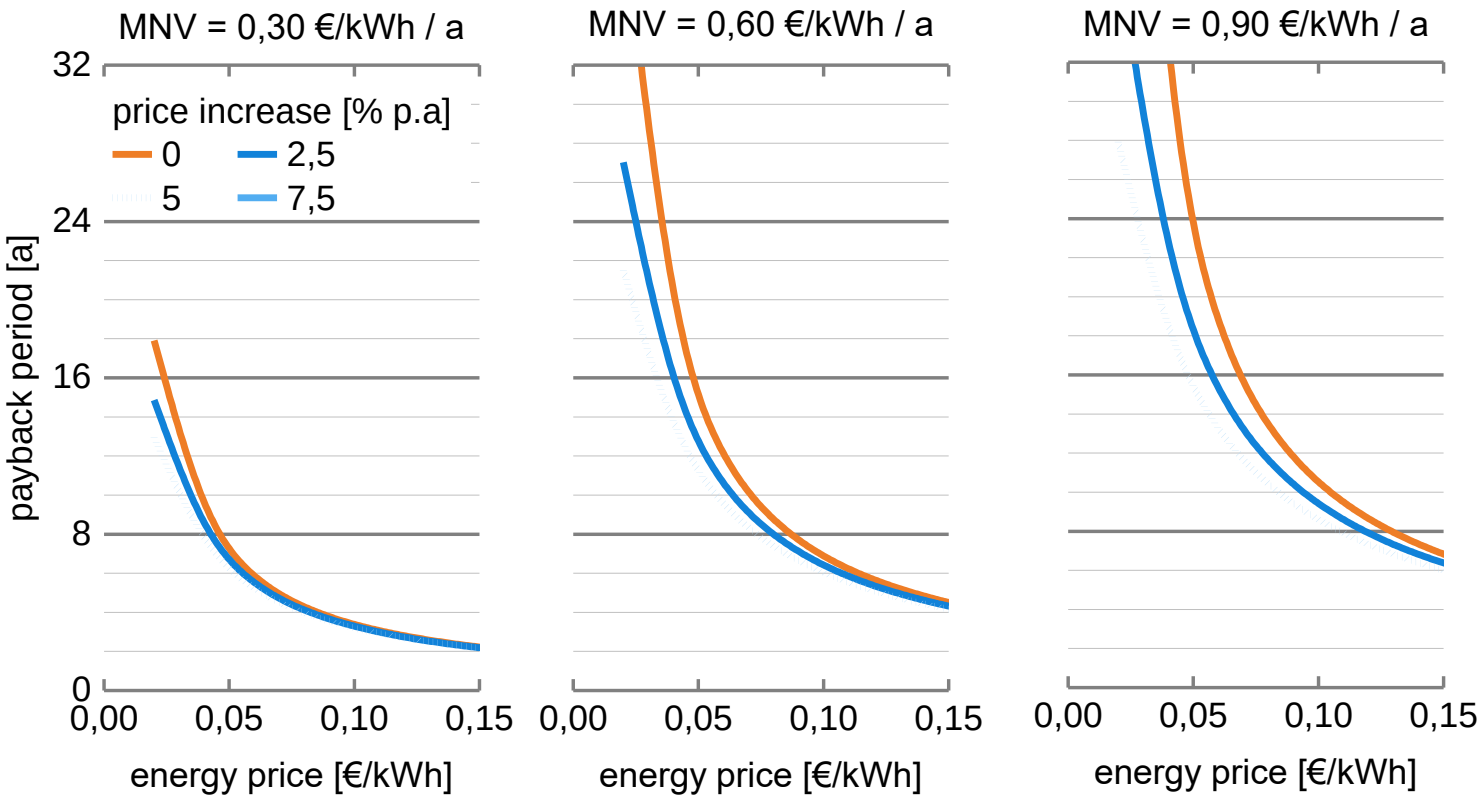
net present value and annuity

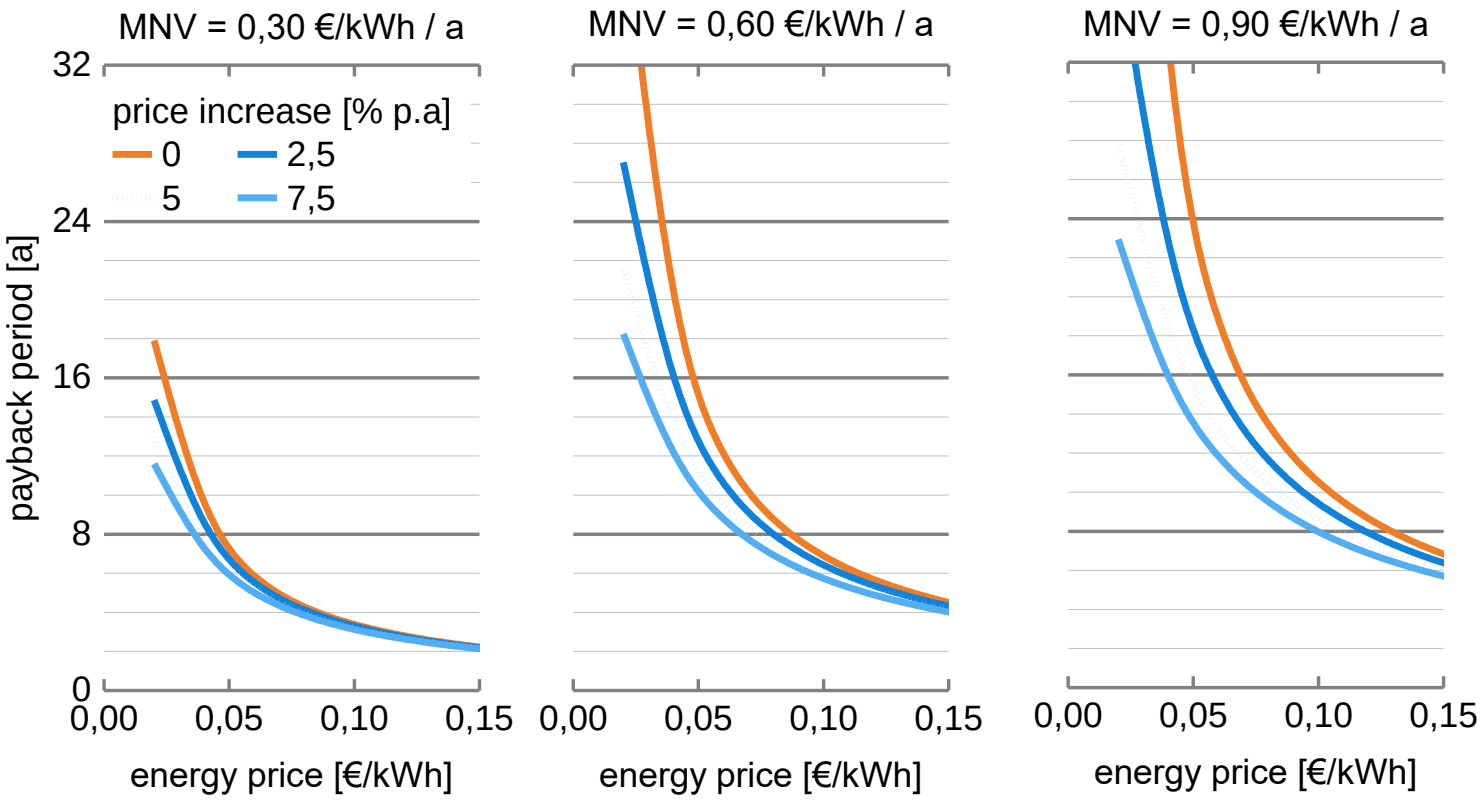


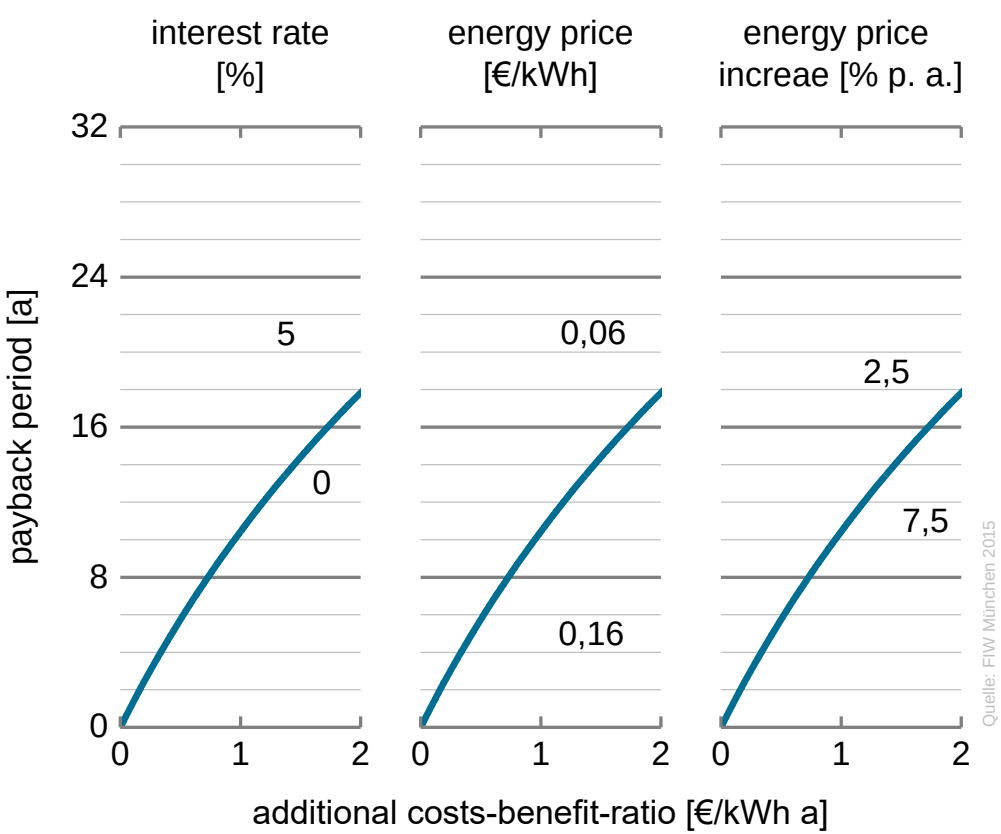
sensitivity study

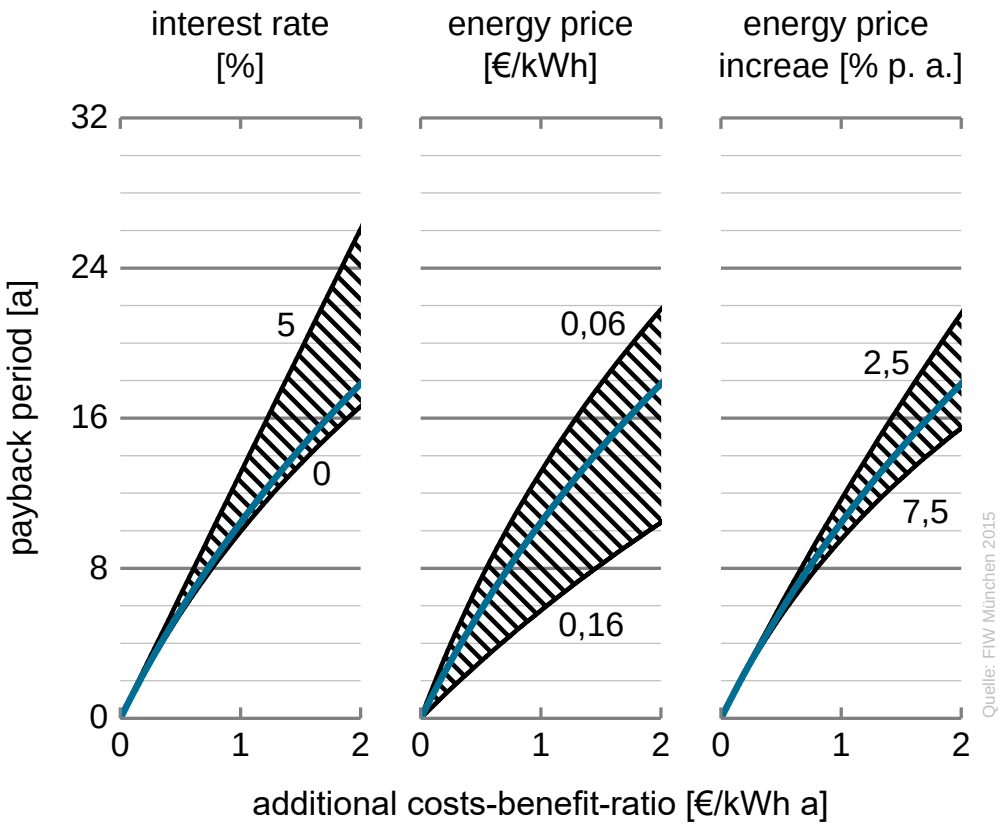

MNV = 0,30 €/kWh / a
MNV = 0,60 €/kWh / a
MNV = 0,90 €/kWh / a
price increase [% p.a]
0
2,5
5
7,5
payback period [a]
32
24
16
8
0
0,00
0,05
0,10
0,15
energy price [€/kWh]


MNV = 0,30 €/kWh / a
MNV = 0,60 €/kWh / a
MNV = 0,90 €/kWh / a
price increase [% p.a]
0
2,5
5
7,5
payback period [a]
32
24
16
8
0
0,00
0,05
0,10
0,15
energy price [€/kWh]


MNV = 0,30 €/kWh / a
MNV = 0,60 €/kWh / a
MNV = 0,90 €/kWh / a
price increase [% p.a]
0
2,5
5
7,5
payback period [a]
32
24
16
8
0
0,00
0,05
0,10
0,15
energy price [€/kWh]


MNV = 0,30 €/kWh / a
MNV = 0,60 €/kWh / a
MNV = 0,90 €/kWh / a
price increase [% p.a]
0
2,5
5
7,5
payback period [a]
32
24
16
8
0
0,00
0,05
0,10
0,15
energy price [€/kWh]


interest rate [%]
energy price [€/kWh]
energy price increae [% p. a.]
payback period [a]
32
24
16
8
0
5
0
0,06
0,16
2,5
7,5
0
1
2
additional costs-benefit-ratio [€/kWh a]
Quelle: FIW München 2015



Quelle: FIW München 2015

consequences

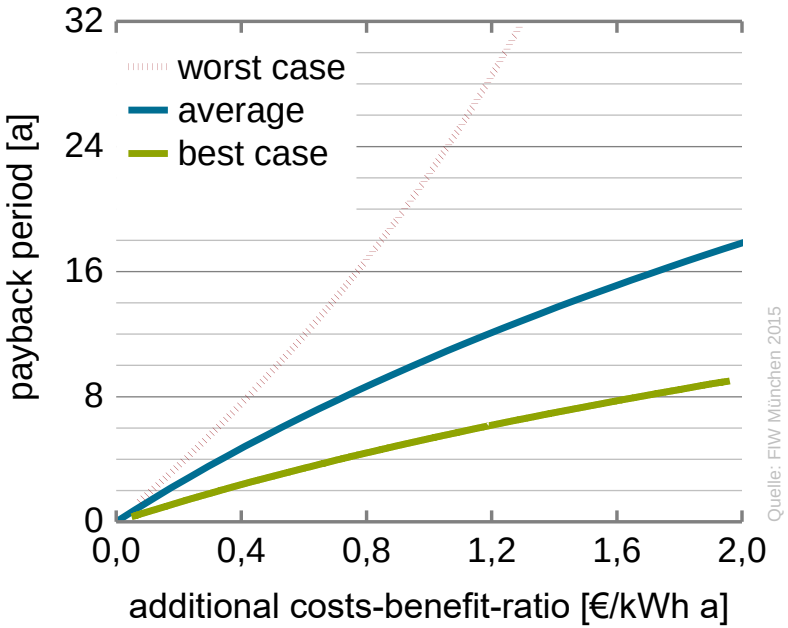
- a variety of parameters affect the amortization time
- new approach necessary:
  - from the deterministic to the stochastic approach

stochastic approach

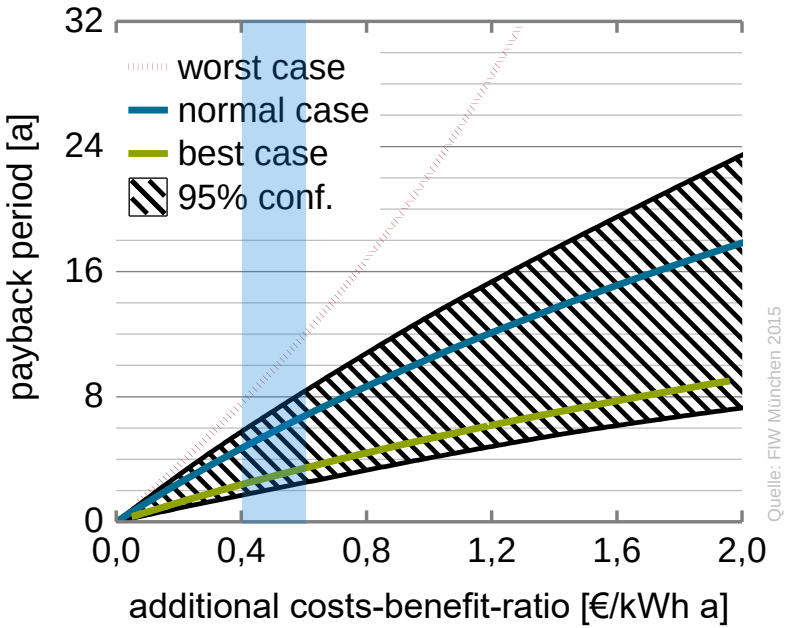
http://upload.wikimedia.org/

stochastic approach

Influencing parameter	Unit	Min.	Mean	Max.
Annual thermal energy-saving by insulating the building section	kWh/m²	68	85	102
Interest used for calculation	%	6.0	2.0	1.0
Inflation rate	%	1.0	1.0	1.0
Real interest rate	%	5.0	1.0	0.0
Initial energy price	€/kWh	0.06	0.08	0.16
Energy price rise	%	2.5	5	7.5

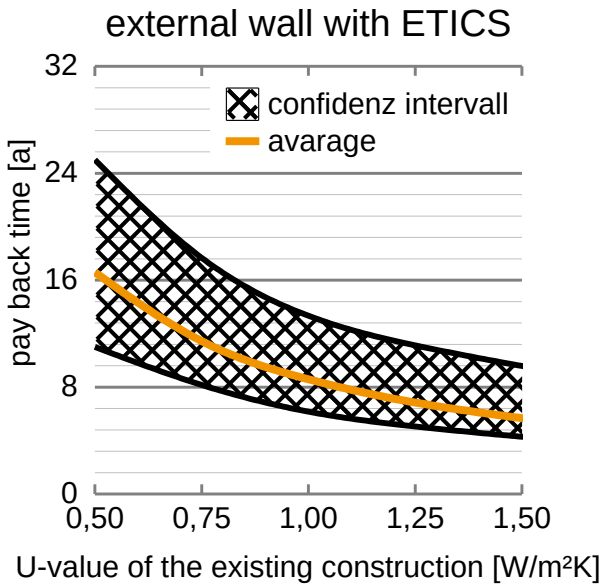


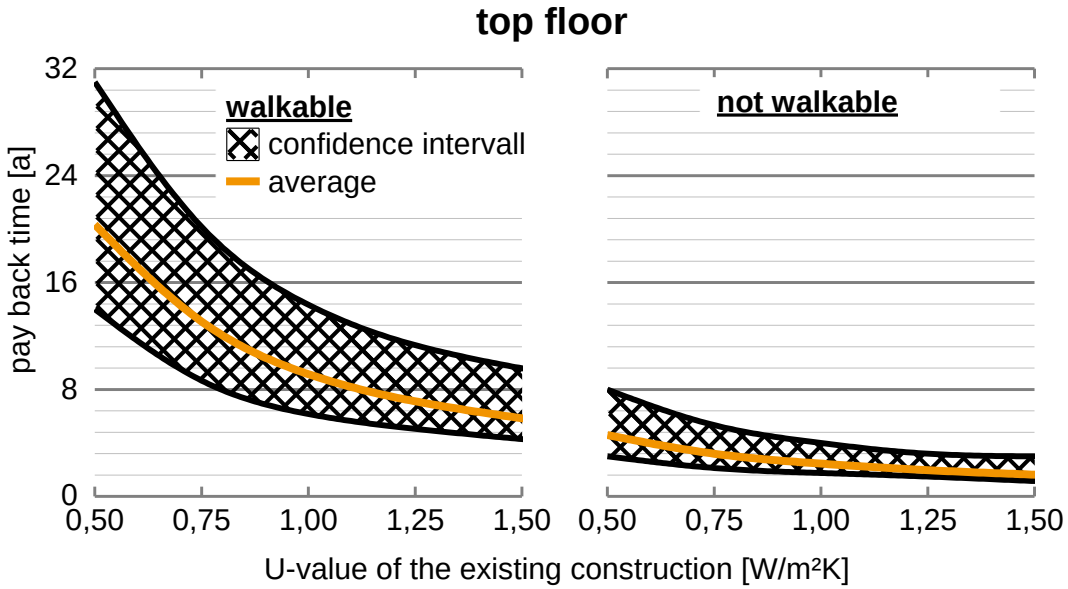
Annahmen: EPS WDVS - Kosten +- 30%
Energiepreis: 0,08 €/kWh

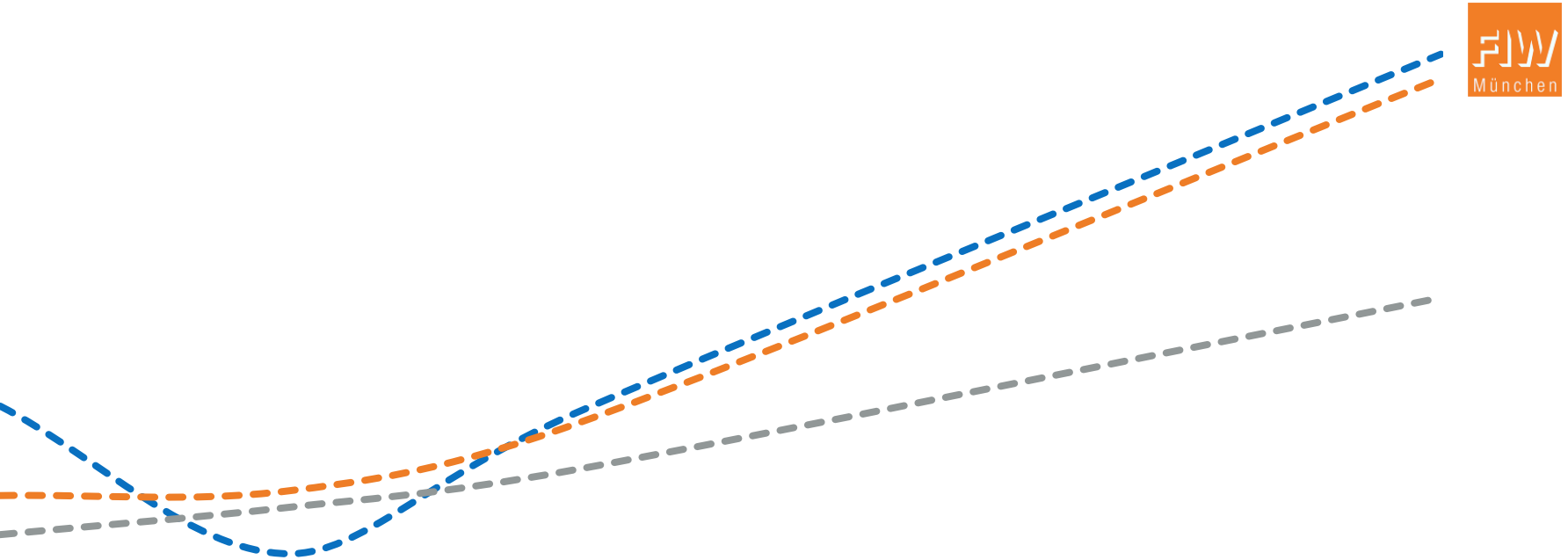


Annahmen: EPS WDVS - Kosten +- 30%
Energiepreis: 0,08 €/kWh

conclusion


external wall with ETICS
32
24
16
8
0
pay back time [a]
confidenz intervall
avarage
0,50
0,75
1,00
1,25
1,50
U-value of the existing construction [W/m²K]


top floor
32
24
16
8
0
pay back time [a]
walkable
confidence intervall
average
not walkable
0,50
0,75
1,00
1,25
1,50
0,50
0,75
1,00
1,25
1,50
U-value of the existing construction [W/m²K]



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holm@fiw-muenchen.de