



Predictability of cost escalation in Infrastructures

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& 29 sept 2022

Introduction

enkele leden SIG PRA



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Program



- Problem definition
- An Approach
- An Example - Dike Reinforcement Project
- Discussion
- Mentimeter

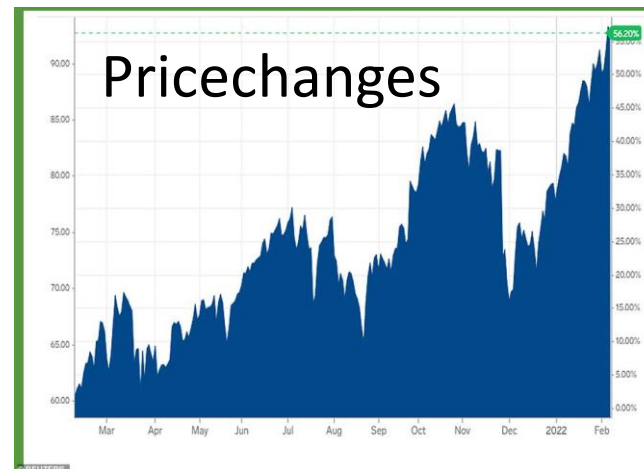
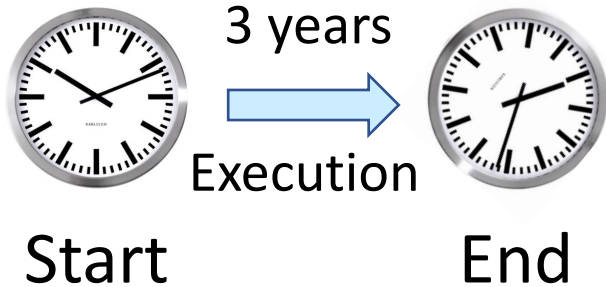
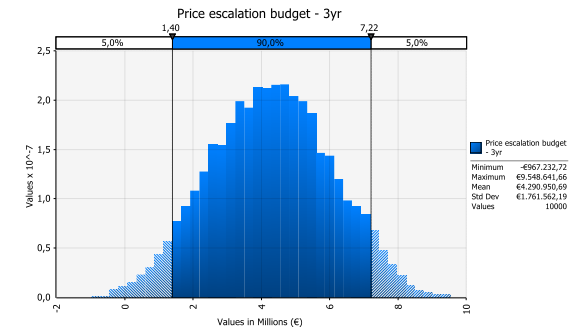
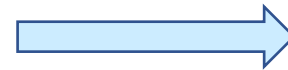
Problem definition

How **to reserve sufficient budget** for cost escalations during the execution phase of projects in infrastructure?



Problem definition

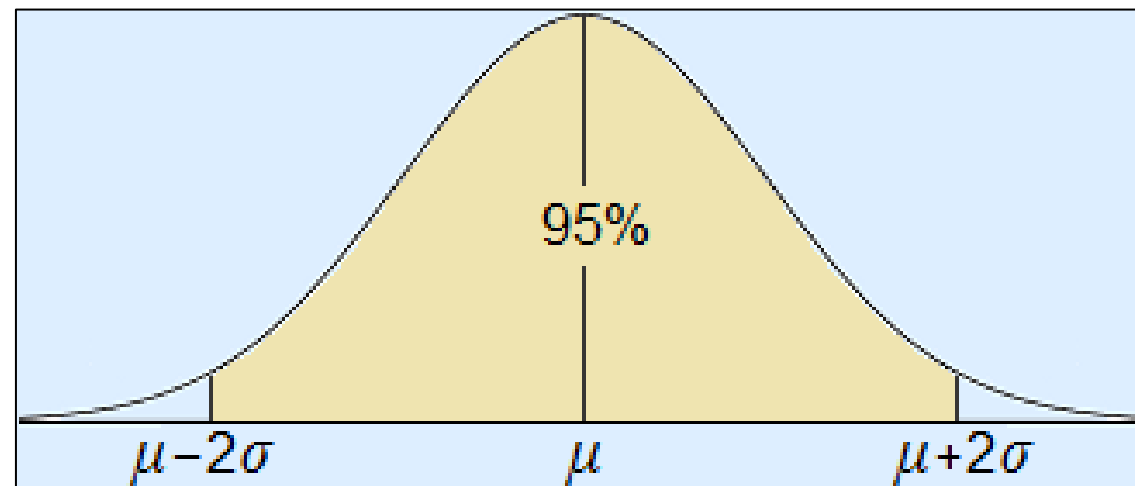
- Execution period several years
- Prices change during this period
- Sufficient funds for Client
- Budget height Contractor
- Risk acceptability / appetite



Budget height

An Approach

1. Use historical index ranges
2. Use a hindcast over 3, 5 or 15 years to make a forecast
3. Use a basket of various specific material or labour indices
4. Linear regression / trendline
5. Calculate the confidence interval of the prediction



An Approach - Indices



= Dutch technology platform for transport, infrastructure and public space

Indices by product groups

	00	01	03	04	11	12	13	14	15	16	17	18	19	20	21	22
2018																
januari	184,5	242,0	377,6	137,0	182,6	164,4	180,6	125,6	126,9	162,4	200,4	246,0	177,4	271,6	257,0	173,7
februari	184,5	234,7	349,9	137,3	184,1	160,4	183,0	125,9	126,9	160,2	200,4	246,1	177,6	254,1	248,5	172,8
maart	184,5	236,1	355,3	141,0	184,2	160,4	182,2	124,7	126,9	160,2	200,4	244,0	178,1	242,5	243,0	172,8
april	184,5	243,2	386,3	135,2	178,6	158,9	182,9	127,2	127,6	160,2	201,9	243,2	176,5	242,5	228,0	170,3
mei	184,5	253,6	419,0	140,8	179,5	162,1	182,0	128,1	127,6	160,5	201,9	241,9	177,0	267,9	240,7	171,8
juni	184,5	253,4	421,9	141,3	179,3	162,1	182,9	129,0	127,6	160,5	203,1	242,5	178,0	294,2	253,5	171,7
juli	184,9	253,2	420,5	142,6	184,1	165,4	179,4	128,3	127,6	160,5	205,1	246,7	181,6	314,1	269,1	174,7
augustus	188,4	254,2	425,2	143,8	182,8	163,0	179,4	129,5	127,6	161,0	205,1	247,2	182,3	315,4	271,4	173,4
september	188,4	258,5	445,3	151,7	186,6	163,0	179,4	133,8	127,4	161,0	205,1	246,1	183,6	315,2	275,6	174,9
oktober	188,5	263,9	477,4	153,4	187,9	163,3	179,3	137,9	127,6	162,2	206,9	238,6	184,7	323,5	278,5	175,5
november	188,5	257,4	420,8	152,2	188,0	164,0	179,1	130,5	127,6	162,6	206,9	239,6	184,0	339,7	286,9	175,8
december	188,5	243,0	361,4	149,6	190,6	164,0	179,5	133,1	127,6	162,6	206,9	240,8	182,9	308,0	272,2	176,8
2019																
januari	187,1	245,8	367,9	171,1	193,1	165,3	188,9	132,7	128,8	166,6	215,2	237,6	181,9	285,6	261,3	178,4
februari	187,1	252,4	390,2	156,7	191,9	166,3	188,9	132,8	128,4	166,7	214,3	235,9	181,2	284,8	260,7	178,3
maart	187,1	255,2	400,3	143,0	193,2	166,3	189,2	133,9	128,1	166,7	214,3	237,2	179,5	302,3	267,8	178,7
april	187,1	258,0	420,1	141,8	194,8	170,0	187,6	133,9	129,7	166,7	214,3	235,3	178,7	306,7	270,3	180,9
mei	187,1	260,1	422,6	137,9	194,2	170,5	189,2	134,8	129,7	168,1	214,3	233,8	175,9	323,1	278,7	180,8
juni	187,1	249,8	382,0	132,1	195,8	170,5	191,3	133,8	129,7	168,1	221,2	230,1	174,6	327,2	279,1	181,4
juli	191,8	251,8	392,8	136,5	195,3	174,2	191,5	136,7	129,9	168,1	225,7	229,0	173,8	317,6	276,7	182,6
augustus	191,8	249,4	379,4	134,1	196,1	170,7	191,2	134,4	129,9	167,2	225,7	226,2	172,1	319,3	277,5	181,7
september	191,8	256,8	401,8	134,4	197,5	170,7	191,2	136,0	129,9	167,2	221,2	220,3	170,5	292,2	265,0	182,2
oktober	191,8	256,6	400,0	135,7	200,6	171,9	190,3	136,1	129,9	167,2	221,2	214,0	168,0	296,6	268,3	183,8
november	191,8	257,0	395,3	142,4	200,5	170,5	190,3	136,0	129,9	167,8	221,2	217,1	167,3	275,6	258,2	183,2
december	191,8	260,9	403,9	138,5	198,9	170,5	190,4	135,7	129,9	167,8	221,2	214,8	166,4	272,5	256,7	182,6
2020																
januari	193,1	264,5	391,0	135,9	202,6	172,6	195,4	138,7	131,7	172,0	226,5	216,2	167,7	276,0	260,1	185,1
februari	193,1															

00 = Labour

01 = Fuel

04 = Electricity

11 = Sand/Clay

14 = Concrete products

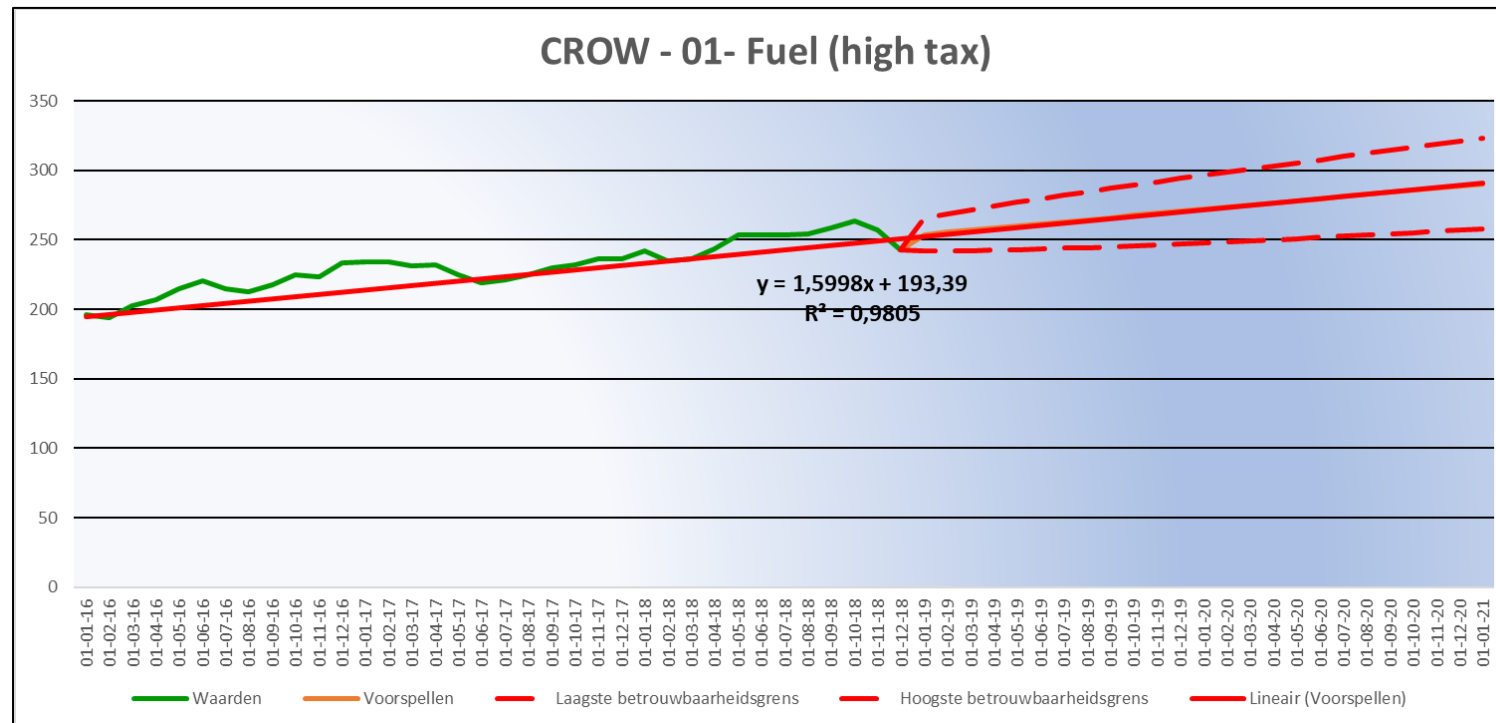
18 = Reinforcing steel

19 = Steel supply

20 = Road construction bitumen

An Approach – Trend and uncertainty

- Trendline Time Serie
- Forecast sheet Excel
- Most Likely and The boundaries (Lowest and Upper)
- ETS = Exponential Tripple Smoothing



An Approach- Induction problem

Drawing conclusions on base of limited cases in the past



Nice boss



Every day lots of food



But at the end....

Certainty of information out of the past is no guarantee for the future.....



Dike Reinforcement Project



Dike Reinforcement Project



Dike Reinforcement project

Execution phase

- Start June 2019
- Completion June 2022

Contract

- Contract Close January 2019

Total costs

- 35 M€

Our Method

Split project in cost components

Using historical data (indices)

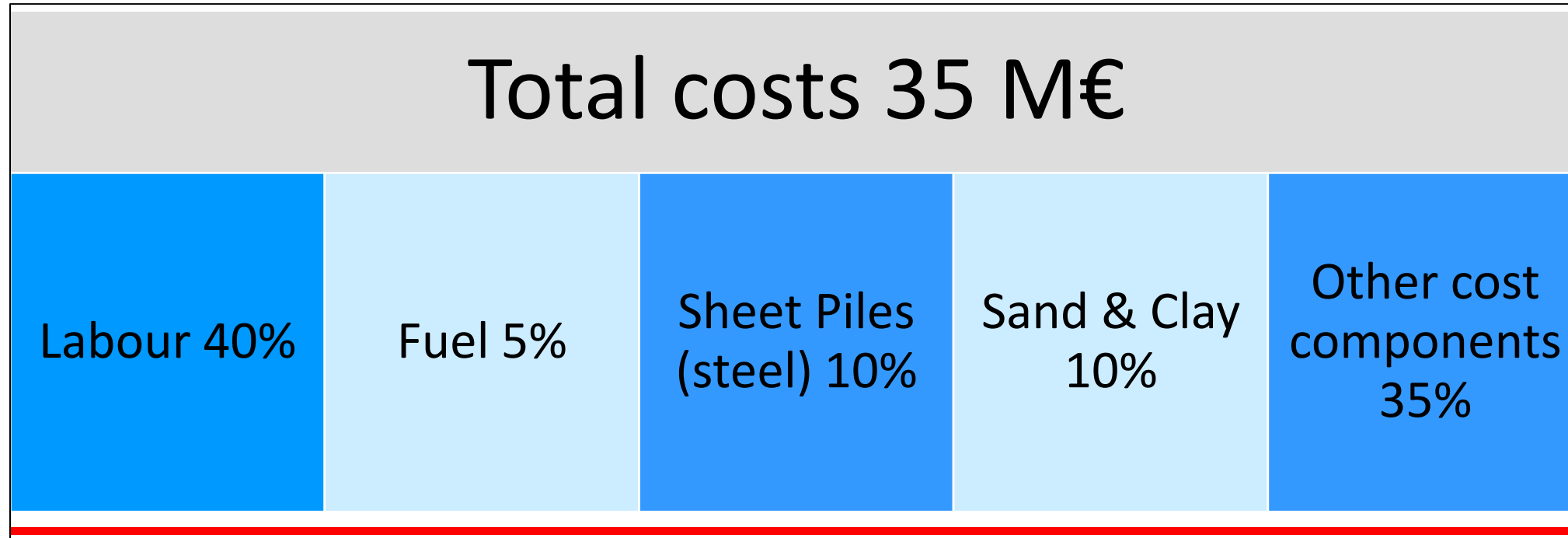
Indices for specific cost components

Execution time 3 years, historical data also 3 years, but also 5 and 15 years

Input data 1-1-'16 until 31-12-'18

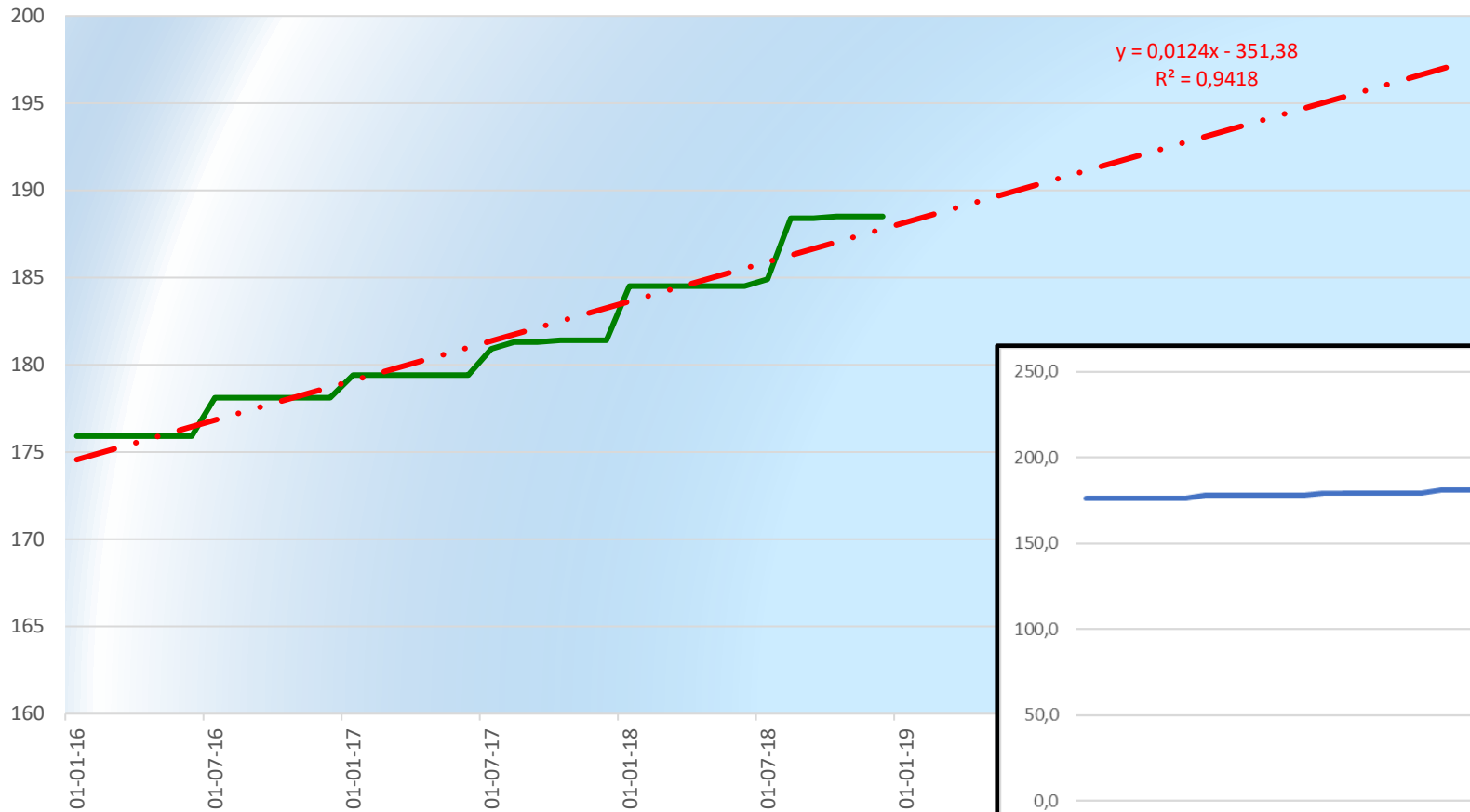
Expected cost increase/decrease half way=1-1-'21

Dike reinforcement project



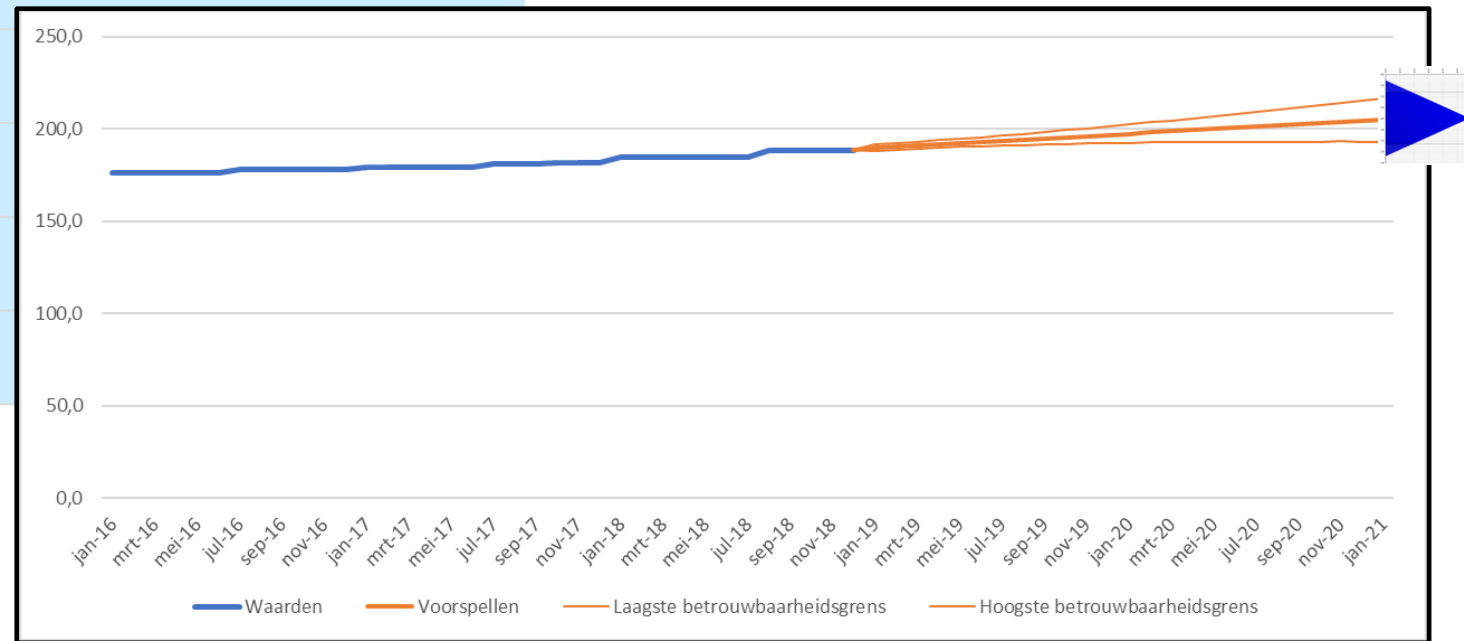
Labour cost index

CROW - 00 - Labour cost index



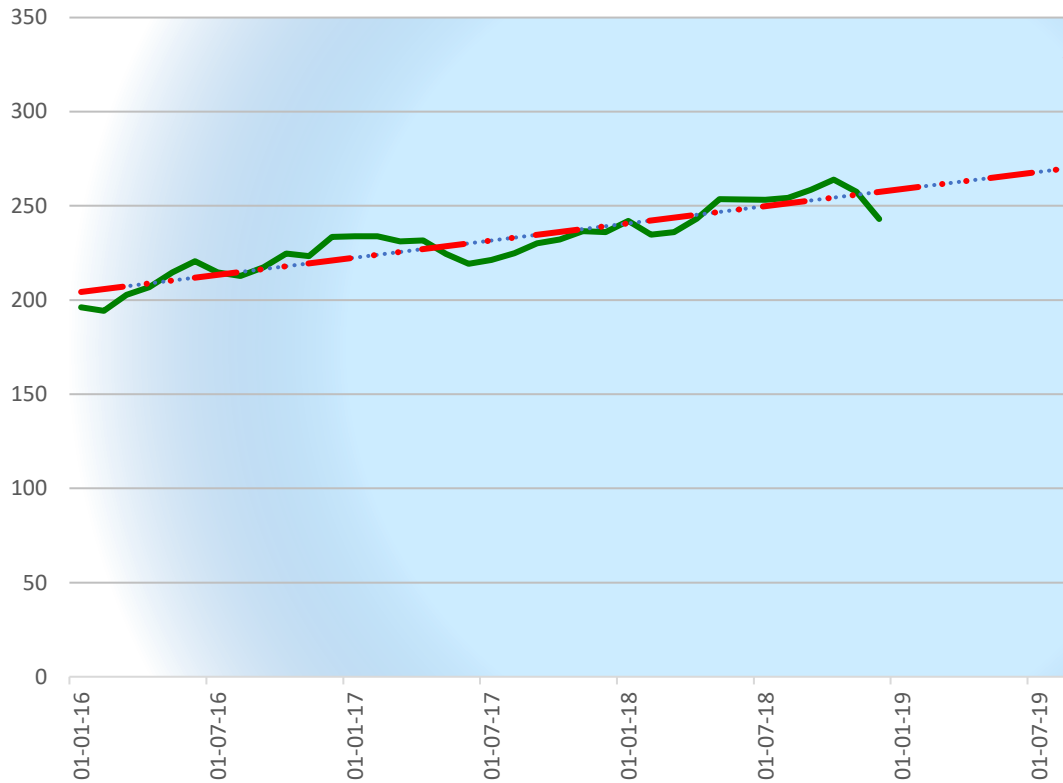
Labour index forecast on 1-1-21:

- Expected **204,8**
- Lower boundary **193,1**
- Upper boundary **216,5**



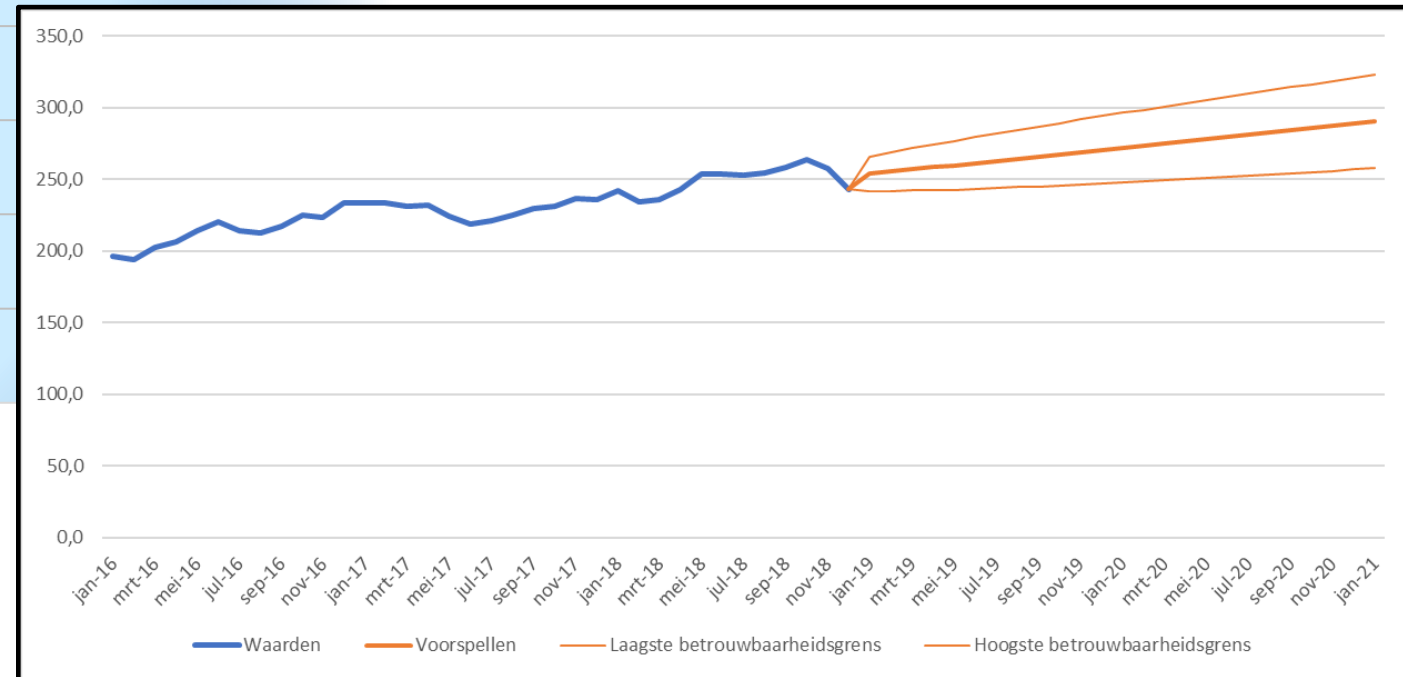
Fuel supply index

CROW - 01- Fuel (high tax)



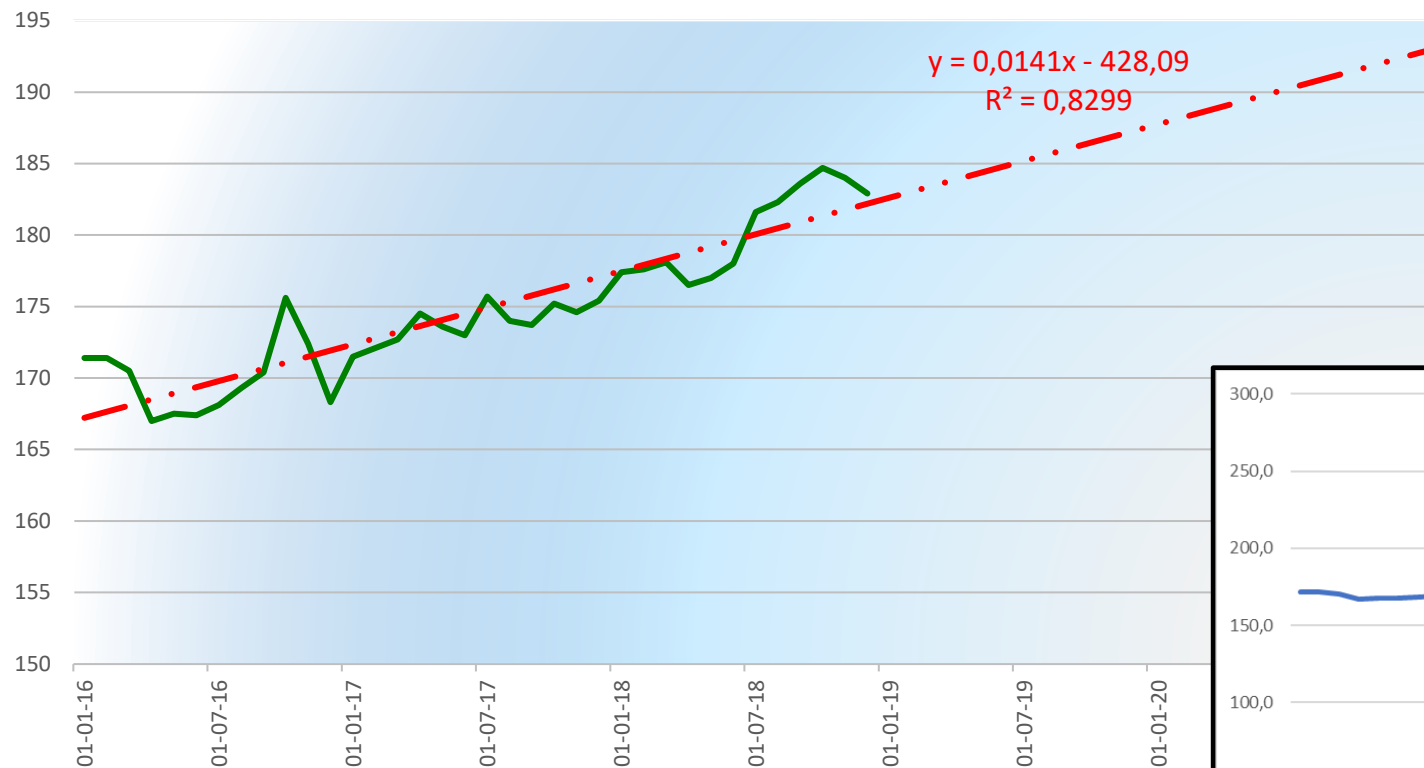
Fuel supply index forecast on 1-1-21:

- Expected **290,3**
- Lower boundary **257,8**
- Upper boundary **322,8**



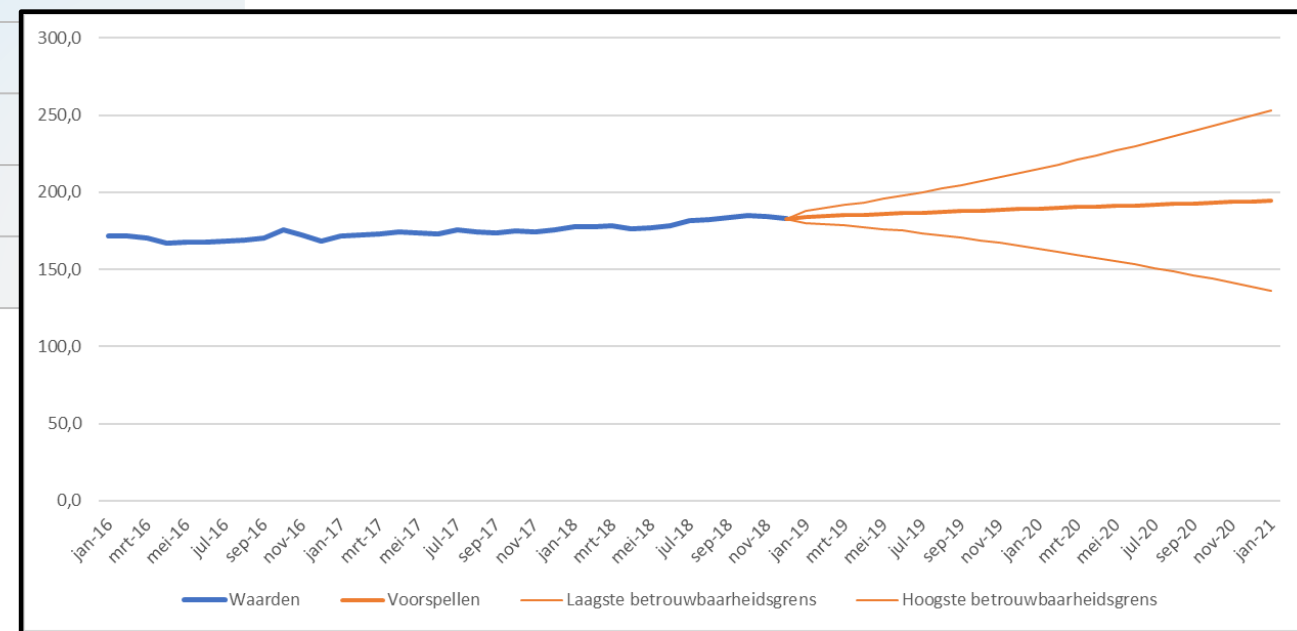
Steel material supply index

CROW - 19 – Steel material supply index



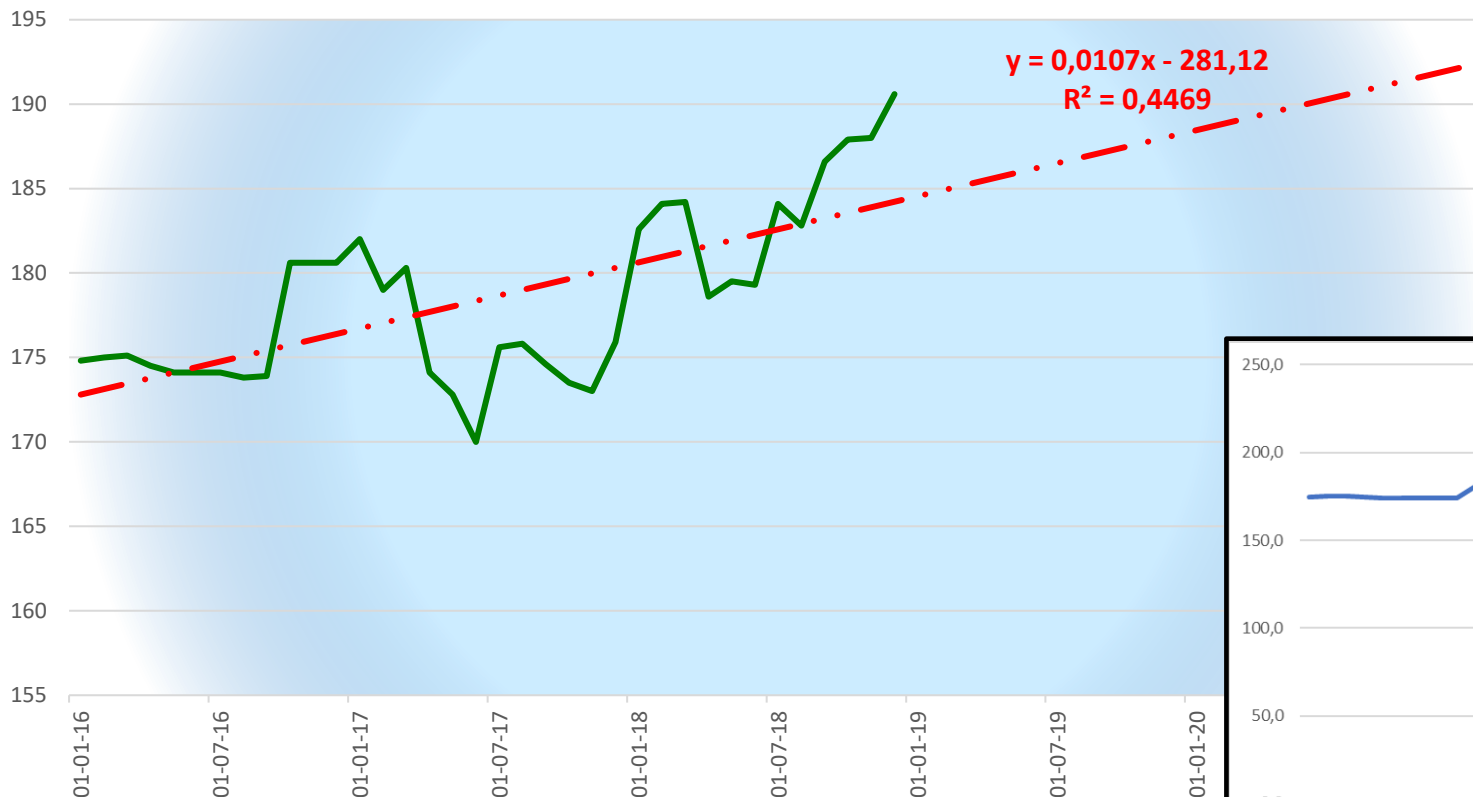
Steel supply index forecast on 1-1-21:

- Expected **194,6**
- Lower boundary **136,1**
- Upper boundary **253,1**



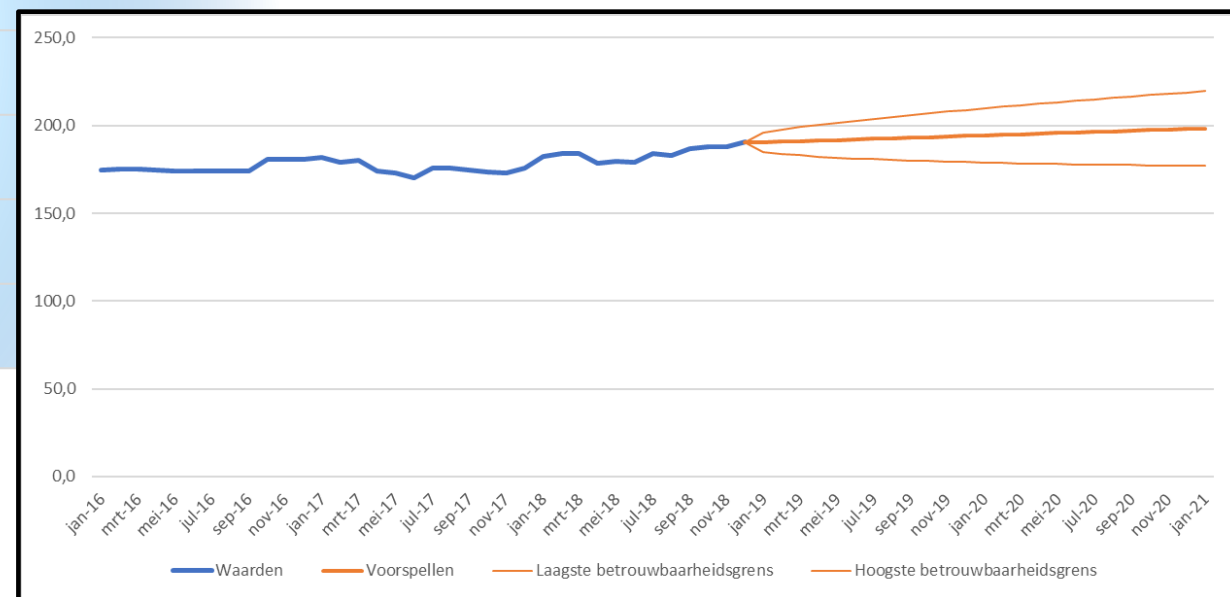
Sand/clay material supply index

CROW - 11 - Sand/Clay



Sand supply index forecast on 1-1-21:

- Expected **198,3**
- Lower boundary **177,0**
- Upper boundary **219,6**



Average hydraulic engineering projects index

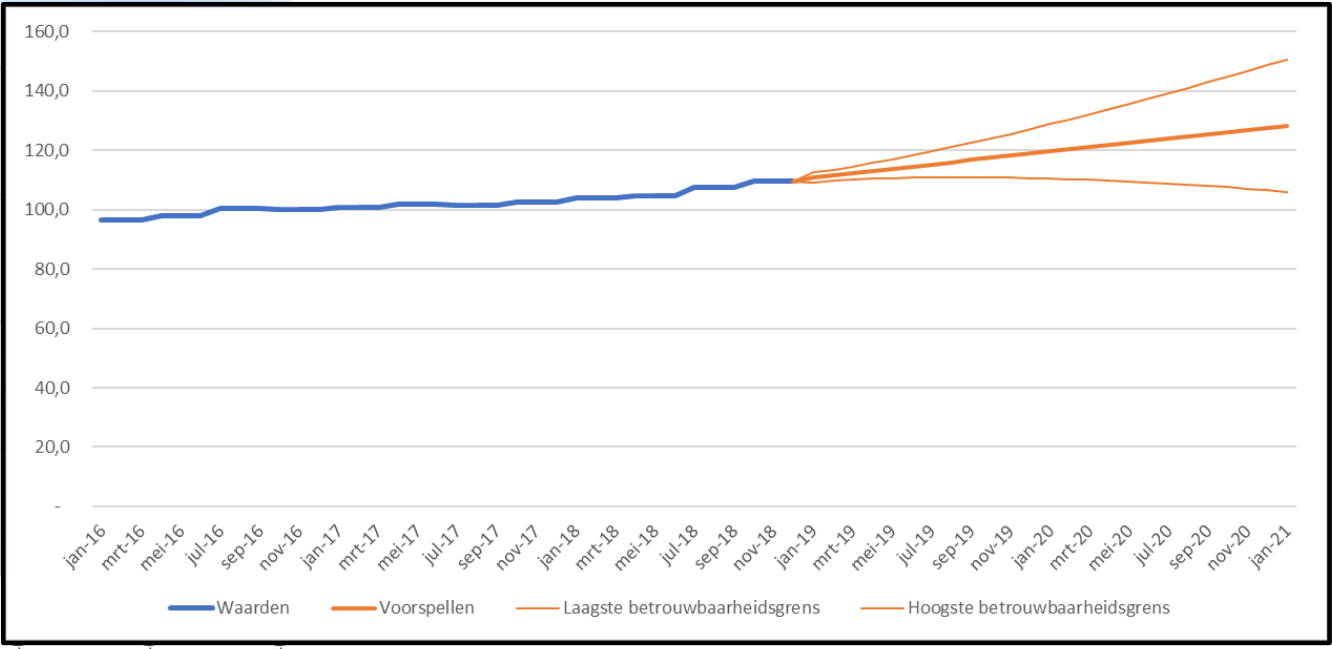


CBS GWW 4291 - Waterbouwkundige werken



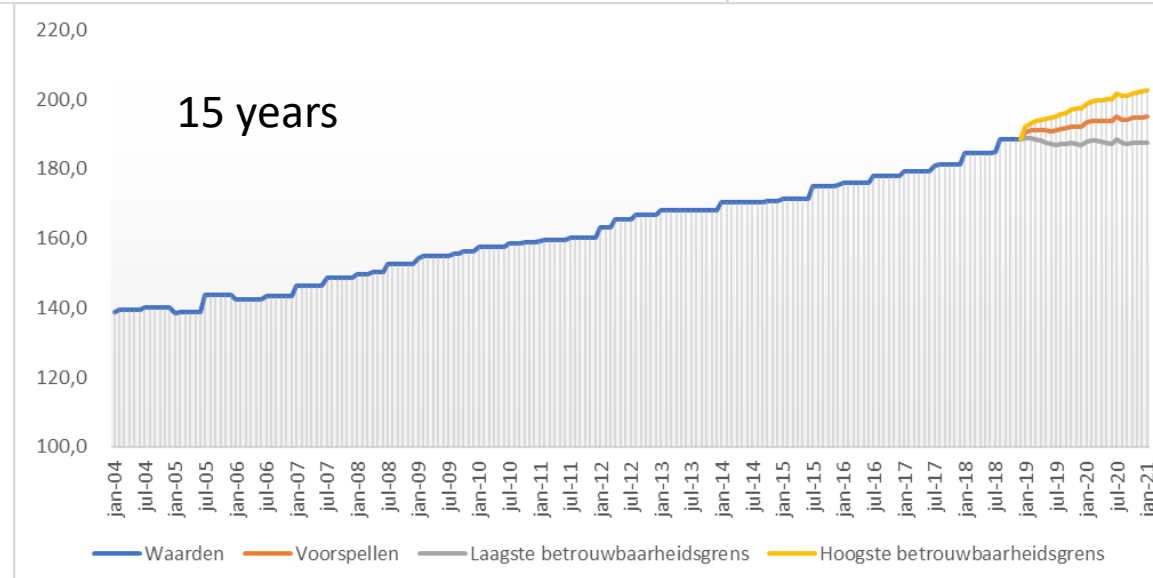
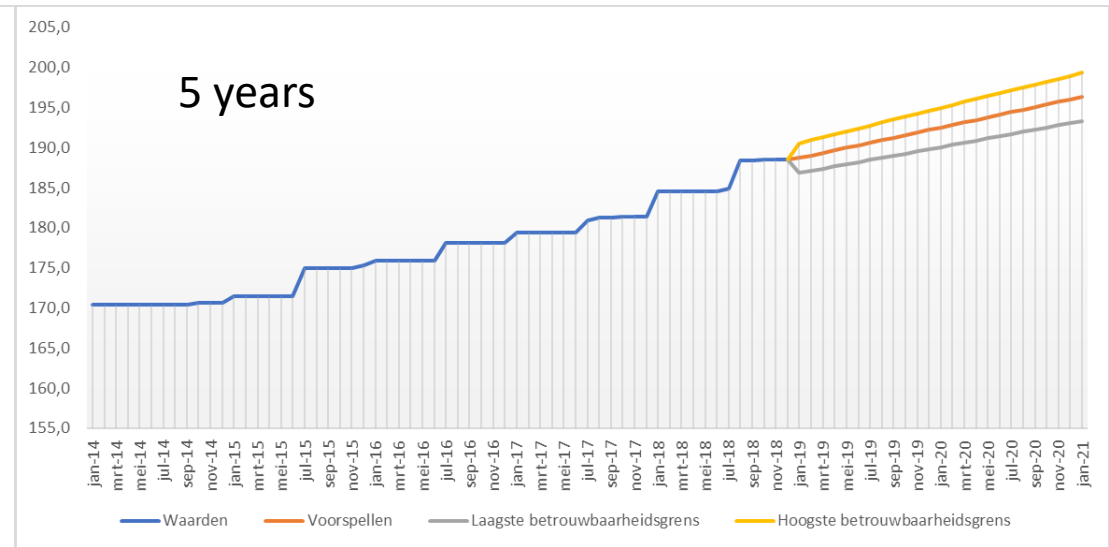
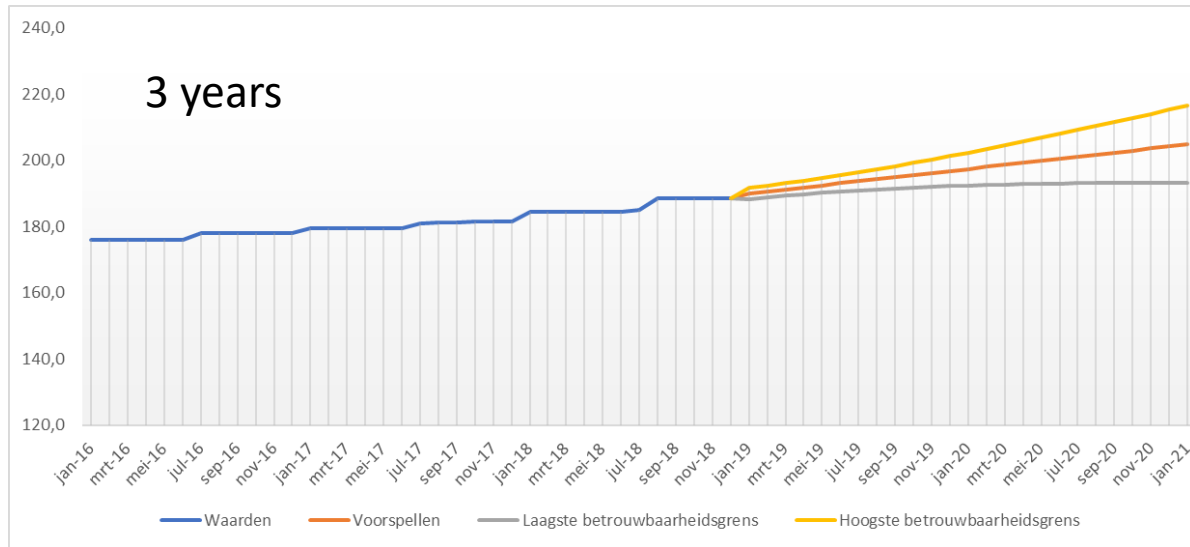
Index forecast on 1-1-21:

- Expected **128,4**
- Lower boundary **106,0**
- Upper boundary **150,7**



Labour cost index

3 – 5 – 15 years historical data





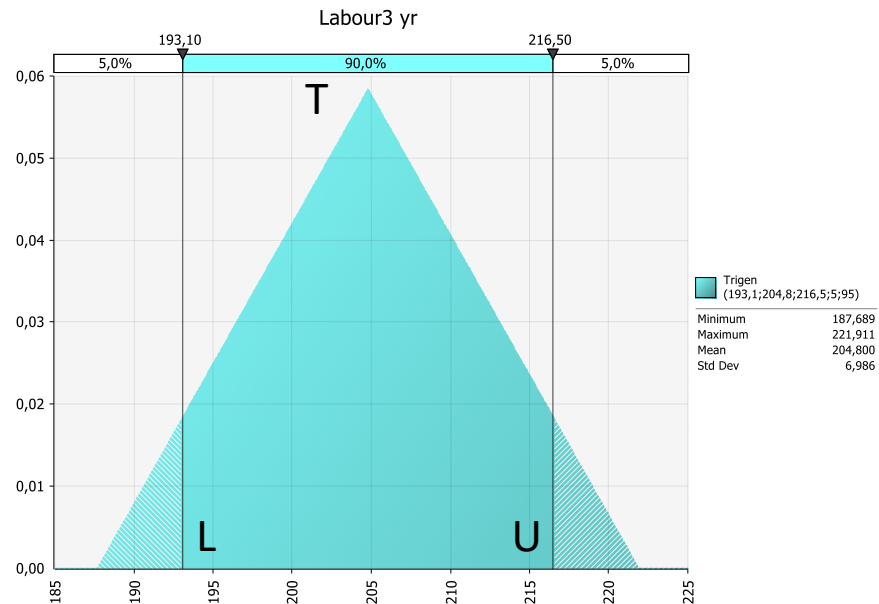
Predictability score of the indices

Historical data 3, 5 and 15 years

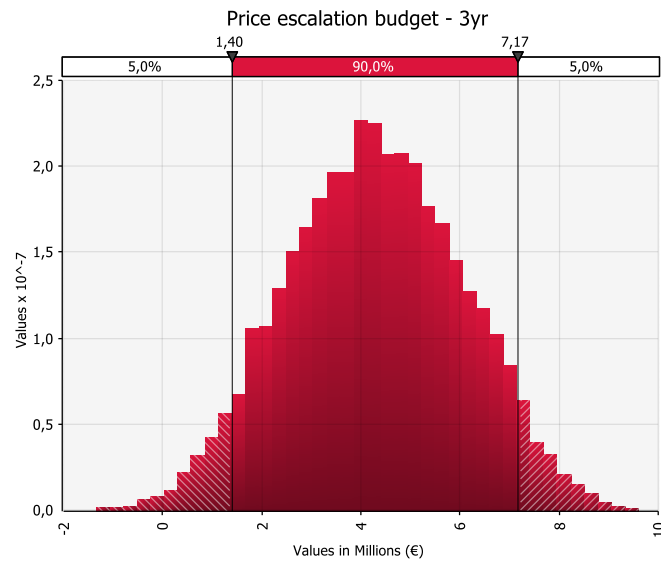
Product Groups	Triangle	3yr	5yr	15yr	Actuals 1-1-2021
Labour	L	193,1	193,4	187,5	197,5
	T	204,8	196,3	195,1	
	U	216,5	199,3	202,6	
Fuel	L	257,8	175,5	201,8	238,5
	T	290,3	239,8	259,1	
	U	322,8	304,2	316,4	
Sand/Clay	L	177,0	181,3	176,3	200,3
	T	198,3	196,6	197,2	
	U	219,6	211,9	218,0	
Steel	L	136,1	168,9	107,4	184,2
	T	194,6	181,1	178,3	
	U	253,1	193,3	249,2	
Hydraulic Project	L	106,0	104,7	104,6	114,9
	T	128,4	111,0	109,6	
	U	150,7	117,3	114,6	

Calculation model

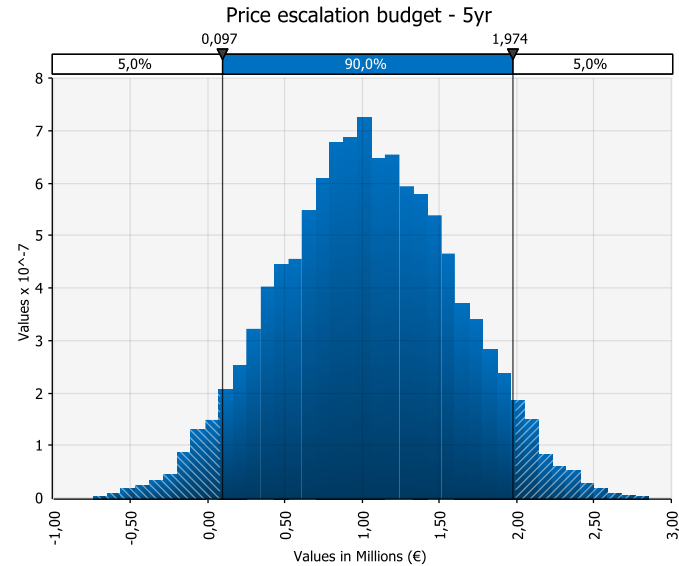
Product groups	%	Product groups total	jan-19	Index januari 2021			Index	Δ	Δ (€)
			Index	Index _L	Index _T	Index _M			
Labour 3yr	40%	€ 14.000.000	187,1	193,1	204,8	216,5	204,8	9%	€ 1.324.425
Steel supply	10%	€ 3.500.000	181,9	136,1	194,6	253,1	194,6	7%	€ 244.365
Sand/Clay supply	10%	€ 3.500.000	193,1	177	198,3	219,6	198,3	3%	€ 94.252
Fuel	5%	€ 1.750.000	245,8	257,8	290,3	322,8	290,3	18%	€ 316.823
Other	35%	€ 12.250.000	108	106	128,4	150,7	128,4	19%	€ 2.310.108
Total	100%	€ 35.000.000						Total	€ 4.289.973



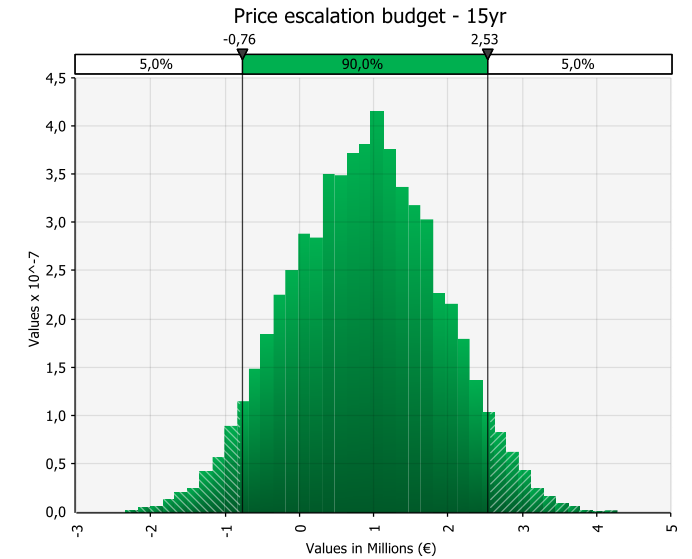
Results based on probabilistic approach



Percentiles	
Percentile	Value
1%	€ 386.496,48
5%	€ 1.400.854,70
10%	€ 1.984.297,87
20%	€ 2.745.747,03
30%	€ 3.329.525,75
40%	€ 3.840.537,25
50%	€ 4.280.276,84
60%	€ 4.756.343,22
70%	€ 5.251.764,18
80%	€ 5.833.192,44
90%	€ 6.616.857,99
95%	€ 7.165.556,72
99%	€ 8.162.330,99

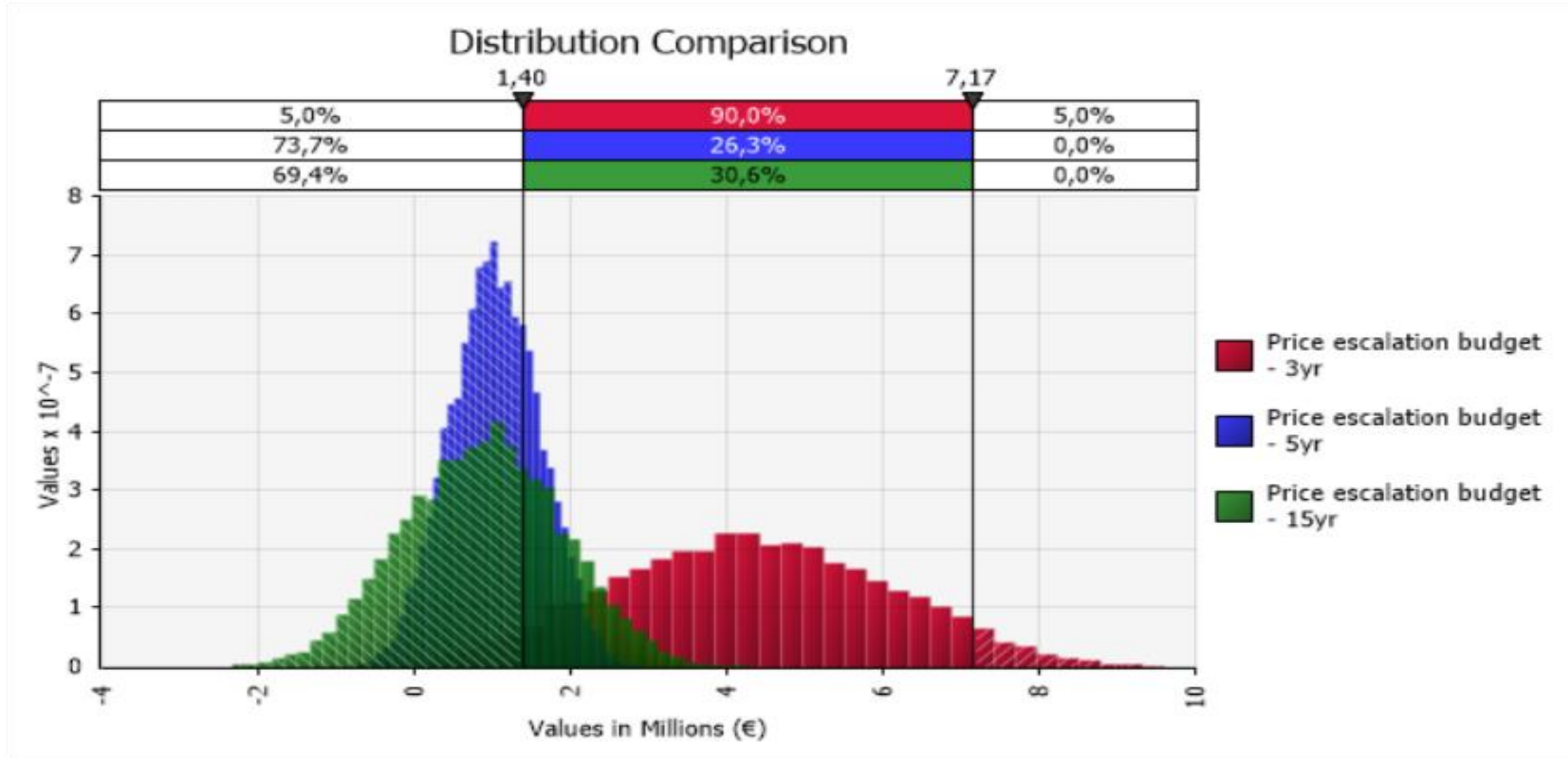


Percentiles	
Percentile	Value
1%	-€ 236.901,28
5%	€ 96.669,09
10%	€ 296.000,89
20%	€ 536.696,43
30%	€ 731.560,76
40%	€ 882.384,31
50%	€ 1.028.694,34
60%	€ 1.175.492,07
70%	€ 1.336.943,41
80%	€ 1.519.775,87
90%	€ 1.777.892,97
95%	€ 1.973.551,24
99%	€ 2.319.598,53



Percentiles	
Percentile	Value
1%	-€ 1.374.340,97
5%	-€ 764.987,06
10%	-€ 434.522,37
20%	€ 2.749,24
30%	€ 345.284,98
40%	€ 629.065,46
50%	€ 896.986,35
60%	€ 1.146.597,26
70%	€ 1.420.736,64
80%	€ 1.733.090,85
90%	€ 2.179.938,47
95%	€ 2.532.586,71
99%	€ 3.109.733,15

Results based on probabilistic approach



Actuals

Product groups	%	Product groups total		Index jan-2019	Index jan-2021		Δ	Δ (€)
Labour 3yr	40%	€ 14.000.000		187,1	197,5		5,6%	€ 778.193
Steel supply	10%	€ 3.500.000		181,9	184,2		1,3%	€ 44.255
Sand/Clay supply	10%	€ 3.500.000		193,1	200,3		3,7%	€ 130.502
Fuel	5%	€ 1.750.000		245,8	238,5		-3,0%	€ -51.973
Other	35%	€ 12.250.000		108	114,9		6,4%	€ 782.639
Total	100%	€ 35.000.000						€ 1.683.617

Probability of actual

3 years history

5 years history

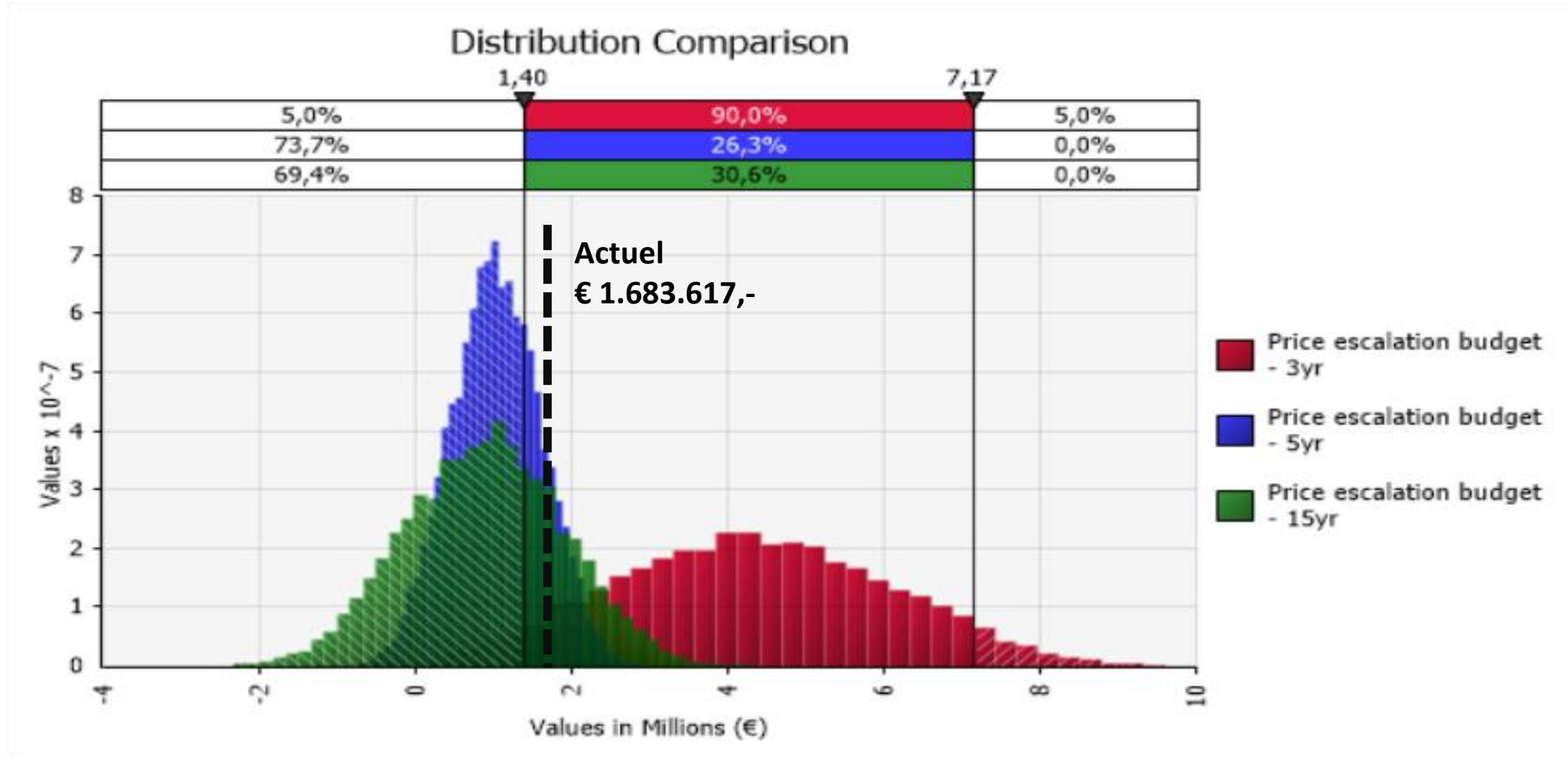
15 years history

5% (P5)

85% (P85)

75% (P75)

Results based on probabilistic approach



Ga naar www.menti.com en gebruik de code **1983 4758**



Experiences or best practices

