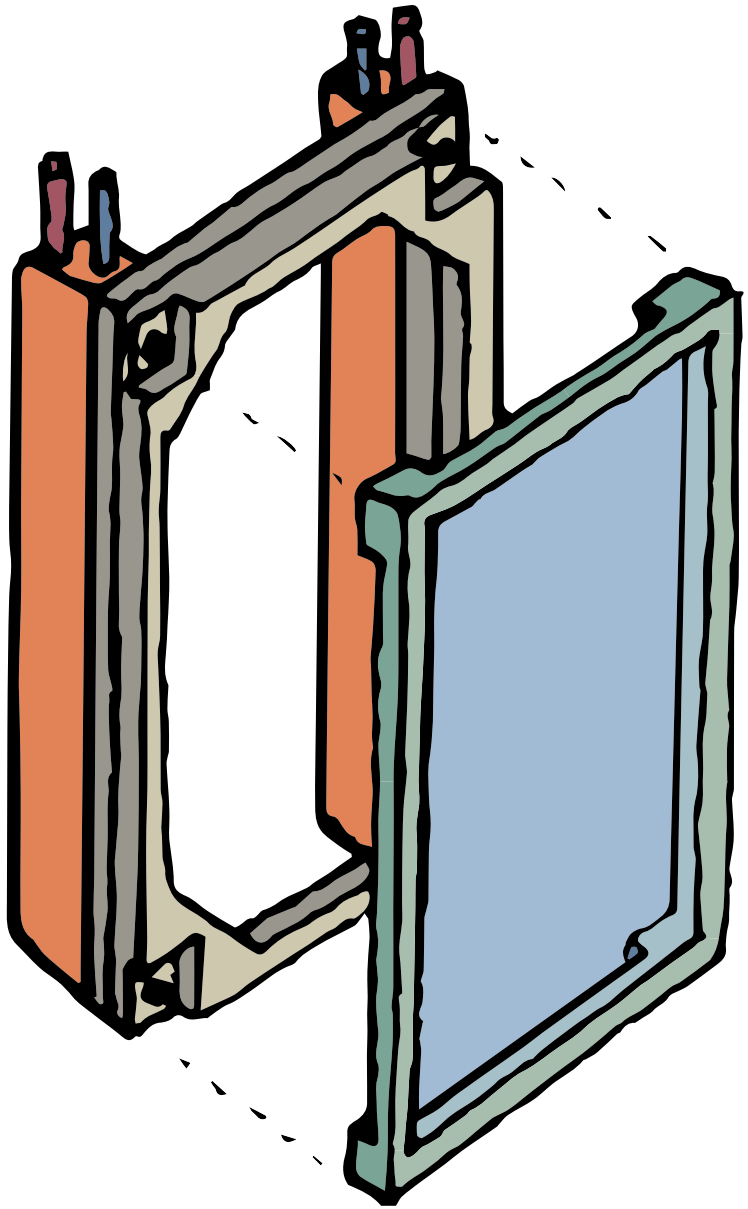
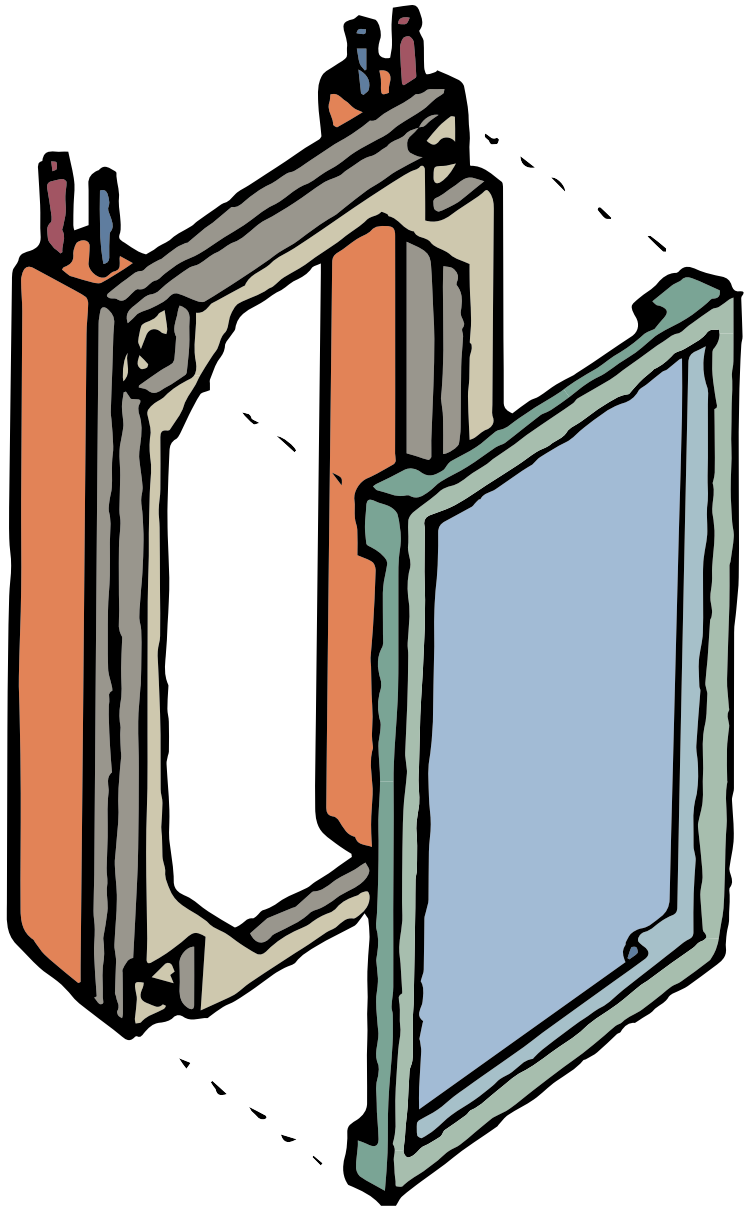
Façade Leasing | Developing a business-to-client product-service system (PSS) for resource-efficient facades



Tutors | Dr.-Ing. Tillmann Klein | *building technologies / facade research group*

Dr.ir. Alexandra den Heijer | *real estate & housing*

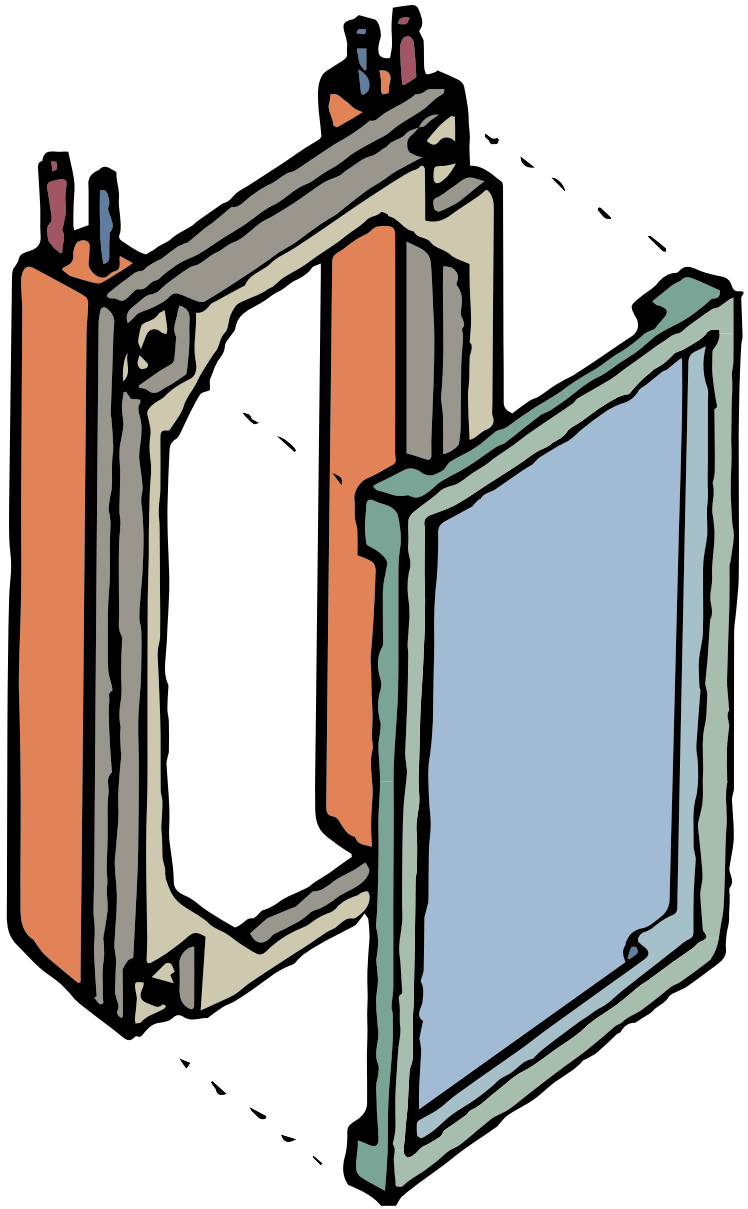


1. Market strategy
2. Schematic service scenarios
3. Case-study and financial model
4. Value-Engineered renovation strategies
5. Evaluation and conclusions

Would a Product-Service System approach lead to broader industry collaboration and more resource-efficient facades?

Where could we find space for improvement in terms of resource and energy use?

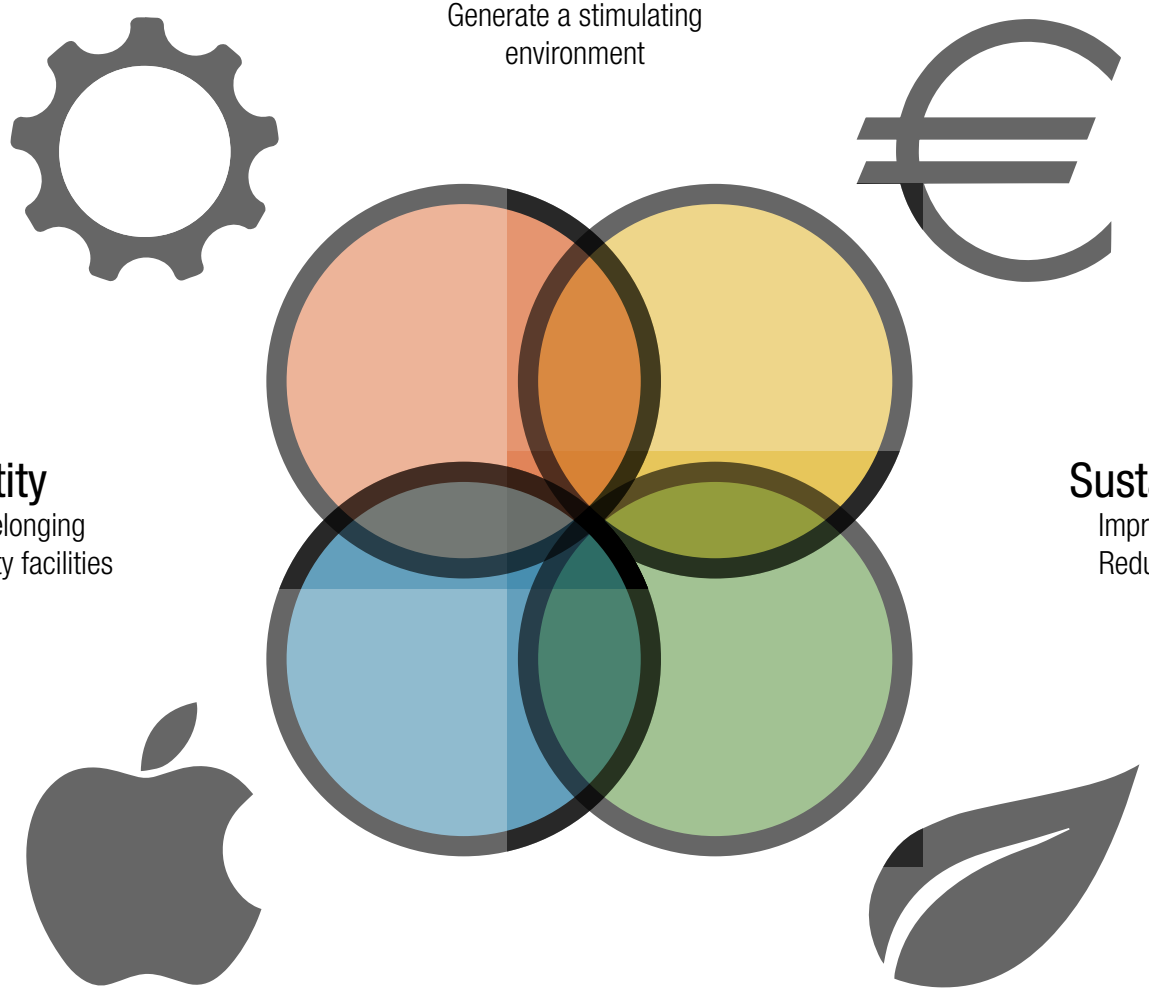
How would construction methods adapt and evolve to new strategies of system management?



1. Market strategy

Productivity

Optimize m² usage
Generate a stimulating environment



Group identity

Generate sense of belonging through inclusive, quality facilities

Sustainable energy

Improve m² performance
Reduce grid dependency

Green marketing

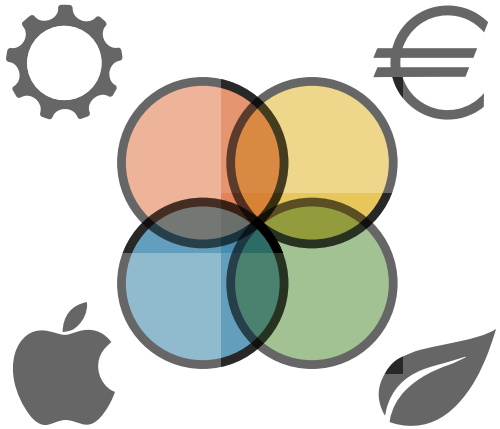
Promote organization's values and cutting-edge technological know-how

Industrial facilities function dictates

Storage block function / commercial activ.

Disneyland high maintenance / high profit

NY by Gehry
Real estate enhanced by branding



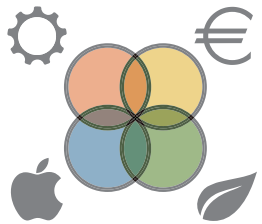
East-block facade renovations
energy cost reduction

ZiggoDome Branding for urban presence

Solar Fabrik sustainability as branding

Igloo local availability, max. performance

University campus



- High 4 value demand
- Investor, manager and end-user are (generally) the same
- Buildings can be used for centuries
- Branding in terms of philosophy and technology
- Building portfolio from the 60's and 70's (almost 50%)
- Low rate of use per m²
- Constant changes in strategic planning

TU Delft BK City

Renovation project impulsed by availability and time restrictions in special circumstances

Harvard GSD Building

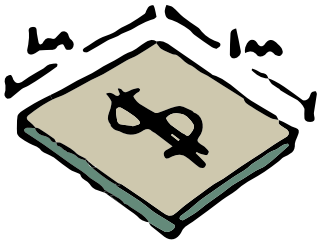
Optimal building functionality, promotion of a specific academic environment

SCI-Arc Building

Branding through the use of an uncommon structure

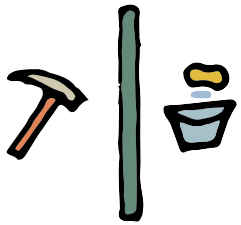
Façade Leasing | Financial models | What types of projects have been funded in the last decade?

Physical Value				Users				Investment					Façade investment potential					
GFA	UFA	UFA:GFA	Floors	Users	M2 UFA per User	Const $ per User	Inv $ per User	Const:Inv Ratio	Cost per m2 (GFA)	Financing costs (per year) 2% long-term interest rate	Operation costs (per year)	OpCosts:Inv	Façade area (40% of gfa)	Façade construction (20% of overall)	Façade cost per m2	Available façade financing (30% of financing costs (20% for facades + 10% for installations) + 30% of operating costs)	Financing per m2 of façade (per year)	Façade PSS financing per year
1300	800	62%	5	173	5		€ 9,827		€ 1,400	€ 34,000	€ 42,000	2%	600	€ 340,000		€ 22,800	€ 40	€ 24,000
3160	2600	82%	3					81%	€ 700	€ 42,000	€ 22,000	1%	1300	€ 420,000	€ 400	€ 19,200	€ 15	€ 19,500
1560	1210	78%	2	350	3	€ 8,286	€ 11,143	74%	€ 2,500	€ 78,000	€ 45,000	1%	700	€ 780,000	€ 1,200	€ 36,900	€ 55	€ 38,500
1620	700	43%	3	103	7	€ 33,010	€ 36,893	89%	€ 2,400	€ 76,000	€ 22,000	1%	700	€ 760,000	€ 1,100	€ 29,400	€ 45	€ 31,500
1910	1328	66%	3	157		€ 20,648	€ 19,288	82%	€ 1,750	€ 57,500	€ 32,750	1%	825	€ 575,000	€ 900	€ 27,100	€ 39	€ 28,375
46100	22200	48%	19	8346	3	€ 6,326	€ 8,687	73%	€ 1,600	€ 1,450,000	€ 1,309,000	2%	18500	€ 14,500,000	€ 800	€ 827,700	€ 45	€ 832,500
16600	13100	79%	8	6568	2	€ 3,365	€ 5,512	61%	€ 2,200	€ 724,000	€ 574,000	2%	6700	€ 7,240,000	€ 1,100	€ 389,400	€ 60	€ 402,000
10700	5250	49%	7	1323	4	€ 6,500	€ 11,413	57%	€ 1,500	€ 302,000	€ 349,000	2%	4300	€ 3,020,000	€ 800	€ 195,300	€ 50	€ 215,000
6930	4190	60%	6						€ 2,400	€ 324,000	€ 300,000	2%	2800	€ 3,240,000	€ 1,200	€ 187,200	€ 70	€ 196,000
36000	21800	61%	6	14890	1	€ 2,700	€ 3,942	68%	€ 1,700	€ 1,174,000	€ 1,095,000	2%	14400	€ 11,740,000	€ 900	€ 680,700	€ 50	€ 720,000
50100	26900	54%		2303	12	€ 36,952	€ 57,620	64%	€ 2,700	€ 2,654,000	€ 1,250,000	1%	20100	€ 26,540,000	€ 1,400	€ 1,171,200	€ 60	€ 1,206,000
5220	2910	56%	6	256	11	€ 39,453	€ 44,922	88%	€ 2,300	€ 230,000	€ 288,000	3%	2100	€ 2,300,000	€ 1,100	€ 155,400	€ 75	€ 157,500
12000	7350	61%	8	961	8	€ 19,979	€ 27,575	72%	€ 2,300	€ 530,000	€ 467,000	2%	4800	€ 5,300,000	€ 1,200	€ 299,100	€ 65	€ 312,000
16900	10600	63%	3	697	15	€ 40,603	€ 64,419	63%	€ 2,700	€ 898,000	€ 363,000	1%	6800	€ 8,980,000	€ 1,400	€ 378,300	€ 60	€ 408,000
14300	9500	66%	5	6964	1	€ 3,791	€ 5,528	69%	€ 2,700	€ 770,000			5800	€ 7,700,000	€ 1,400	€ 231,000	€ 40	€ 232,000
6310	4070	65%	4	155	26	€ 164,516	€ 169,032	97%	€ 4,200	€ 524,000	€ 233,000	1%	2600	€ 5,240,000	€ 2,100	€ 227,100	€ 90	€ 234,000
11100	6130	55%	8	707	9	€ 23,197	€ 31,966	73%	€ 2,100	€ 452,000	€ 298,000	1%	4500	€ 4,520,000	€ 1,100	€ 225,000	€ 50	€ 225,000
13200	6730	51%	13	3241	2	€ 6,695	€ 9,627	70%	€ 2,400	€ 624,000	€ 574,000	2%	5300	€ 6,240,000	€ 1,200	€ 359,400	€ 70	€ 371,000
20100	12500	62%	13	4170	3		€ 9,568		€ 2,000	€ 798,000	€ 1,572,000	4%	8100	€ 7,980,000	€ 1,000	€ 711,000	€ 90	€ 729,000
5320	3520	66%	4	156	23	€ 56,410	€ 82,051	69%	€ 2,500	€ 256,000	€ 253,000	2%	2200	€ 2,560,000	€ 1,200	€ 152,700	€ 70	€ 154,000
10200	6280	62%	3	298	21	€ 44,295	€ 63,087	70%	€ 1,900	€ 376,000			4100	€ 3,760,000	€ 1,000	€ 112,800	€ 30	€ 123,000
29900	17100	57%	6	1050	16	€ 41,524	€ 59,524	70%	€ 2,100	€ 1,250,000	€ 1,739,000	3%	12000	€ 12,500,000	€ 1,100	€ 896,700	€ 75	€ 900,000
7760	4430	57%	4	49	90	€ 453,061	€ 642,857	70%	€ 4,100	€ 630,000	€ 575,000	2%	3200	€ 6,300,000	€ 2,000	€ 361,500	€ 115	€ 368,000
2680	1920	72%	2	65	30	€ 63,077	€ 72,308	87%	€ 1,800	€ 94,000	€ 110,000	2%	1100	€ 940,000	€ 900	€ 61,200	€ 60	€ 66,000
5650	3520	62%	4	308	11	€ 20,455	€ 28,571	72%	€ 1,600	€ 176,000			2300	€ 1,760,000	€ 800	€ 52,800	€ 25	€ 57,500
35300	20900	59%	8	3260	6	€ 16,564	€ 23,282	71%	€ 2,200	€ 1,518,000	€ 1,351,000	2%	14200	€ 15,180,000	€ 1,100	€ 860,700	€ 65	€ 923,000
13300	8580	65%	6	1584	5	€ 14,141	€ 16,414	86%	€ 2,000	€ 520,000	€ 530,000	2%	5400	€ 5,200,000	€ 1,000	€ 315,000	€ 60	€ 324,000
20500	12100	59%	4	4989	2		€ 10,804		€ 2,700	€ 1,078,000	€ 904,000	2%	8200	€ 10,780,000	€ 1,400	€ 594,600	€ 75	€ 615,000
70300	46900	67%	5	4830	10	€ 24,886	€ 38,571	65%	€ 2,700	€ 3,726,000	€ 4,671,000	3%	28200	€ 37,260,000	€ 1,400	€ 2,519,100	€ 90	€ 2,538,000
19436	11603	61%	6	2920		€ 51,833	€ 64,664	72%	€ 2,350	€ 878,250	€ 895,500	2%	7821	€ 8,782,500	€ 1,362	€ 498,600	€ 64	€ 512,854
5000	2040	41%	4	270	8	€ 18,148	€ 27,407	66%	€ 1,500	€ 148,000	€ 208,000	3%	2000	€ 1,480,000	€ 800	€ 106,800	€ 55	€ 110,000
4770	2190	46%	4	354	6	€ 12,147	€ 18,644	65%	€ 1,400	€ 132,000	€ 175,000	3%	2000	€ 1,320,000	€ 700	€ 92,100	€ 50	€ 100,000
49400	23600	48%	12	800	30		€ 24,125		€ 400	€ 386,000	€ 2,313,000	12%	19800	€ 3,860,000	€ 200	€ 809,700	€ 45	€ 891,000
13800	8380	61%	3					95%	€ 600	€ 160,000	€ 55,000	1%	5600	€ 1,600,000	€ 300	€ 64,500	€ 15	€ 84,000
8900	5800	65%	2	1240	5		€ 11,935		€ 1,700	€ 296,000			3600	€ 2,960,000	€ 900	€ 88,800	€ 25	€ 90,000
4800	3020	63%	2	7820	0		€ 1,471		€ 2,400	€ 230,000			2000	€ 2,300,000	€ 1,200	€ 69,000	€ 35	€ 70,000
26000	15800	61%	11	2515	6	€ 11,173	€ 15,109	74%	€ 1,500	€ 760,000	€ 1,043,000	3%	10400	€ 7,600,000	€ 800	€ 540,900	€ 55	€ 572,000
1730	780	45%	3	500	2	€ 4,600	€ 5,600	82%	€ 1,700	€ 56,000	€ 534,000	19%	700	€ 560,000	€ 800	€ 177,000	€ 255	€ 178,500
10800	7660	71%	11	548	14	€ 20,073	€ 26,460	76%	€ 1,400	€ 290,000	€ 609,000	4%	4400	€ 2,900,000	€ 700	€ 269,700	€ 65	€ 286,000
1730	870	50%	5					85%	€ 800	€ 26,000	€ 55,000	4%	700	€ 260,000	€ 400	€ 24,300	€ 35	€ 24,500
12693	7014	55%	6	1405		€ 13,228	€ 16,344	78%	€ 1,400	€ 248,400	€ 624,000	6%	5200	€ 2,484,000	€ 1,000	€ 224,300	€ 64	€ 240,600
15817	9314	60%	6	2154		€ 42,712	€ 49,291	74%	€ 2,100	€ 626,200	€ 725,100	3%	6400	€ 6,261,100	€ 1,300	€ 376,800	€ 61	€ 390,211



Construction cost / m²

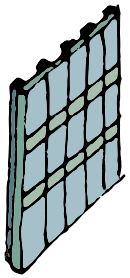
Avg = € 2,000 / m²
Max = € 4,100 / m²
Min = € 400 / m²



Cons : Oper Ratio

Avg = 3%
Max = 20%
Min = 1%

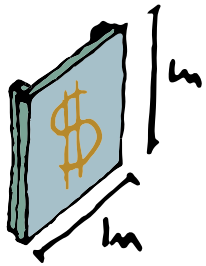
= GFA x 40%
Average ratio for low-rise, non-iconic buildings



Facade area

Avg = 5,000 m²
Max = 28,000 m²
Total = 240,000 m²

= InvCost x 20%
Average ratio of facade costs against overall investment costs



Facade cost / m²

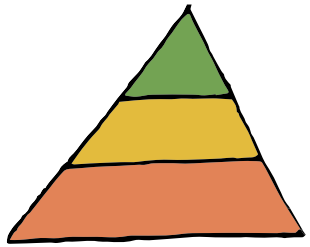
Avg = € 1,000 / m²
Max = € 2,000 / m²
Min = € 400 / m²

Source: 3 Parker, David. , 2013. The Tall Buildings Reference Book. Edition. Routledge

Façade Leasing | Project Analysis | What types of projects have been funded in the last decade?

General Information						Strategic Value	Functional Value						Financial Value					GFA	UFA	UFA:GFA
Code	Project	Campus	Project Type	Year	Location	Maslow's Pyramid	M2 ufa / student	M2 ufa / staff	Students	Staff	FTE	Student:staff ratio	Maintenance	Energy	Cleaning	Construction	Investment			
UU-5	Drift 10	Inner city	Acquisition + Renovation	2008	Utrecht	Plain & Efficient		7.6		93	80			€ 30,000	€ 12,000		€ 1,700,000			
RUG-3	Storage Library	Zernike	Expansion	2006	Groningen	Meeting Place	–	–	–	–	–		€ 12,000		€ 10,000	€ 1,700,000	€ 2,100,000			
RUG-6	GMW Education	Inner city	Expansion	2008	Groningen	Meeting Place	3.4		350	0	0		€ 17,000	€ 13,000	€ 15,000	€ 2,900,000	€ 3,900,000			
VU-2	W&N Faculty	VU Campus	Expansion	2008	Amsterdam	Meeting Place		11.5		52	51				€ 22,000	€ 3,400,000	€ 3,800,000			
Averages													€ 14,500	€ 21,500	€ 14,750	€ 2,666,667	€ 2,875,000			
EUR-2	T Building	Woudestein	New	2005	Rotterdam	Meeting Place	0.5	18.6	6888	793	665	4.72	€ 368,000	€ 537,000	€ 404,000	€ 52,800,000	€ 72,500,000			
EUR-3	L Building	Woudestein	New	1990	Rotterdam	Meeting Place	0.3	15.15	5679	537	352	6.39	€ 199,000	€ 193,000	€ 182,000	€ 22,100,000	€ 36,200,000			
UM-1	UNS 60 Building	Randwyck	New	2004	Maastricht	Meeting Place	1.8	14.8	968	200	155	2.73	€ 81,000	€ 110,000	€ 158,000	€ 8,600,000	€ 15,100,000			
LEI-1	Van Oort Building	Leeuwenhoek	New	1998	Leiden	Representative	–	–	–	–	–		€ 90,000	€ 125,000	€ 85,000		€ 16,200,000			
RU-1	Gymnasion	Heyendaal	New	2003	Nijmegen	Meeting Place	0.3	0.9	12000	2890		4.15	€ 209,000	€ 265,000	€ 621,000	€ 40,200,000	€ 58,700,000			
RU-2	Huygens	Heyendaal	New	2006	Nijmegen	Meeting Place	2.3	13.6	1491		812	1.84	€ 1,250,000			€ 85,100,000	€ 132,700,000			
RUG-1	Zernikeborg	Zernike	New	2003	Groningen	Representative	2	15.8	170	86		1.98	€ 112,000	€ 110,000	€ 66,000	€ 10,100,000	€ 11,500,000			
RUG-4	Bernoulliborg	Zernike	New	2007	Groningen	Representative	2.9	17.5	537	248	176	1.27	€ 172,000	€ 166,000	€ 129,000	€ 19,200,000	€ 26,500,000			
UU-1	NITG Building	De Uithof	New	2002	Utrecht	Representative	4.4	12.4	340	357		0.95	€ 75,000	€ 118,000	€ 170,000	€ 28,300,000	€ 44,900,000			
UU-2	Hijmans van der Bergh	De Uithof	New	2005	Utrecht	Representative	0.8	15.8	6802	162		41.99				€ 26,400,000	€ 38,500,000			
UU-3	Jeanette Donker-Voet	De Uithof	New	2006	Utrecht	Plain & Efficient		6.4		155			€ 147,000		€ 86,000	€ 25,500,000	€ 26,200,000			
UvT-1	Tias Building	Tilburg	New	2002	Tilburg	Representative	4.7	12.4	444	263		1.69	€ 111,000	€ 79,000	€ 108,000	€ 16,400,000	€ 22,600,000			
UvA-1	REC E Faculty	Roeterseiland	New	1999	Amsterdam	Meeting Place	0.4	15.6	2583	353	305	3.93	€ 279,000	€ 167,000	€ 128,000	€ 21,700,000	€ 31,200,000			
VU-1	OZW Building	VU Campus	New	2006	Amsterdam	Representative	1.8	11	3669	294	207	7.32	€ 797,000	€ 400,000	€ 375,000		€ 39,900,000			
TUD-2	L&R Extension	TU Campus	New	2002	Delft	Plain & Efficient	2.4	15.5	12	144		0.08	€ 146,000	€ 107,000		€ 8,800,000	€ 12,800,000			
UT-3	Meander	Drienerlo	New	2007	Twente	Representative		11.6	61	237		0.26				€ 13,200,000	€ 18,800,000			
TUE-1	Helix	TU/e	New	1998	Eindhoven	Plain & Efficient	3.9	15.4	700	350		2.00	€ 316,000	€ 1,079,000	€ 344,000	€ 43,600,000	€ 62,500,000			
TUE-3	Spectrum	TU/e	New	2002	Eindhoven	Representative		11.5		25	24		€ 165,000	€ 365,000	€ 45,000	€ 22,200,000	€ 31,500,000			
WU-1	Main Building Lisse	Lisse Terrein	New	2003	Lisse	Meeting Place		14.5			65		€ 59,000	€ 27,000	€ 24,000	€ 4,100,000	€ 4,700,000			
WU-2	Rikilt Building	Wageningen	New	2009	Wageningen	Meeting Place		8.8		154	154					€ 6,300,000	€ 8,800,000			
WU-3	Forum Building	Wageningen	New	2007	Wageningen	Representative	2.7	28.7	3000	130	130	11.54	€ 600,000	€ 521,000	€ 230,000	€ 54,000,000	€ 75,900,000			
TUD-1	TBM Faculty	TU Campus	New (2 phases)	2000	Delft	Meeting Place	1.7	15.1	962	352	270	1.55	€ 273,000	€ 124,000	€ 133,000	€ 22,400,000	€ 26,000,000			
LEI-2	Kamerlingh Onnes	Inner city	New + Renovation	2004	Leiden	Representative	0.5	13.6	4286	411	292	6.10	€ 225,000	€ 384,000	€ 295,000		€ 53,900,000			
UvA-2	FNWI Faculty	Science Park	New + Renovation	2010	Amsterdam	Meeting Place	3	10.2	2170	1500	1160	0.82	€ 2,474,000	€ 1,161,000	€ 1,036,000	€ 120,200,000	€ 186,300,000			
Averages													€ 388,000	€ 317,789	€ 243,105	€ 31,009,524	€ 43,912,500			
UM-2	Bonnefanestraat 2	Inner city	Renovation	2005	Maastricht	Plain & Efficient	0	10.5	0	160	110	0.00	€ 73,000	€ 67,000	€ 68,000	€ 4,900,000	€ 7,400,000			
UM-3	Zwingelput 4	Inner city	Renovation	2006	Maastricht	Meeting Place	5.7	12	300	30	24	5.56	€ 72,000	€ 43,000	€ 60,000	€ 4,300,000	€ 6,600,000			
UU-4	Kruyt Building	De Uithof	Renovation	2009	Utrecht	Plain & Efficient	5.6	14.4	350	450		0.78	€ 1,903,000		€ 410,000		€ 19,300,000			
TUD-3	Mijnbouwstraat 120	TU Campus	Renovation	2009	Delft	Representative	–	–	–	–	–		€ 55,000			€ 7,600,000	€ 8,000,000			
UT-1	Noordhorst & Oosthorst	Drienerlo	Renovation	2004	Twente	Plain & Efficient	3	10.7	1200	40		30.00					€ 14,800,000			
UT-2	Westhorst	Drienerlo	Renovation	2005	Twente	Plain & Efficient	8.5	8.9	4800	3020		1.59					€ 11,500,000			
TUE-2	Vertigo, Faculty BK	TU/e	Renovation	2002	Eindhoven	Representative	2.2	13.5	1957	336	222	3.51	€ 391,000	€ 308,000	€ 344,000	€ 28,100,000	€ 38,000,000			
TUE-4	Black Box	TU/e	Renovation	2006	Eindhoven	Representative		0.3		500			€ 153,000	€ 339,000	€ 42,000	€ 2,300,000	€ 2,800,000			
RUG-5	FEB Offices	Zernike	Renovation (rethink)	2007	Groningen	Meeting Place		12.1		548			€ 246,000	€ 231,000	€ 132,000	€ 11,000,000	€ 14,500,000			
RUG-2	Education Building	Inner city	Transformation	2005	Groningen	Plain & Efficient	–	–	–	–	–		€ 25,000	€ 13,000	€ 17,000	€ 1,100,000	€ 1,300,000			
Averages									861	508	36		€ 291,800	€ 100,100	€ 107,300	€ 5,930,000	€ 12,420,000			
Overall Averages				2004					1624	391	138		€ 357,903.23	€ 262,296.30	€ 191,700.00	€ 23,177,419.35	€ 31,305,263.16			

Strategic value of projects



Operation costs breakdown for a commercial building

Standard costs ($/sq ft 2009)	Cost	%	Potential PSS
Cleaning	$ 1.50	13%	3%
Maintenance	$ 1.75	15%	5%
Utilities	$ 2.25	19%	10%
Grounds	$ 0.25	2%	
Security	$ 0.75	6%	
Administrative	$ 1.25	11%	3%
Fixed	$ 4.00	34%	6%
	$ 11.75	100%	**27%**

Notes: 1

Source: 2. BOMA. 2010. Practical Industry Intelligence for Commercial Real Estate

Façade Leasing | Financial models | How much could a client invest in such a system?

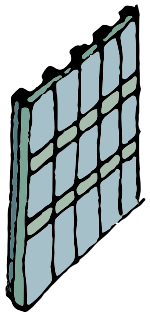
Physical Value				Users				Investment					Façade investment potential					
GFA	UFA	UFA:GFA	Floors	Users	M2 UFA per User	Const $ per User	Inv $ per User	Const:Inv Ratio	Cost per m2 (GFA)	Financing costs (per year) 2% long-term interest rate	Operation costs (per year)	OpCosts:Inv	Façade area (40% of gfa)	Façade construction (20% of overall)	Façade cost per m2	Available façade financing (30% of financing costs (20% for facades + 10% for installations) + 30% of operating costs)	Financing per m2 of façade (per year)	Façade PSS financing per year
1300	800	62%	5	173	5		€ 9,827		€ 1,400	€ 34,000	€ 42,000	2%	600	€ 340,000		€ 22,800	€ 40	€ 24,000
3160	2600	82%	3					81%	€ 700	€ 42,000	€ 22,000	1%	1300	€ 420,000	€ 400	€ 19,200	€ 15	€ 19,500
1560	1210	78%	2	350	3	€ 8,286	€ 11,143	74%	€ 2,500	€ 78,000	€ 45,000	1%	700	€ 780,000	€ 1,200	€ 36,900	€ 55	€ 38,500
1620	700	43%	3	103	7	€ 33,010	€ 36,893	89%	€ 2,400	€ 76,000	€ 22,000	1%	700	€ 760,000	€ 1,100	€ 29,400	€ 45	€ 31,500
1910	1328	66%	3	157		€ 20,648	€ 19,288	82%	€ 1,750	€ 57,500	€ 32,750	1%	825	€ 575,000	€ 900	€ 27,100	€ 39	€ 28,375
46100	22200	48%	19	8346	3	€ 6,326	€ 8,687	73%	€ 1,600	€ 1,450,000	€ 1,309,000	2%	18500	€ 14,500,000	€ 800	€ 827,700	€ 45	€ 832,500
16600	13100	79%	8	6568	2	€ 3,365	€ 5,512	61%	€ 2,200	€ 724,000	€ 574,000	2%	6700	€ 7,240,000	€ 1,100	€ 389,400	€ 60	€ 402,000
10700	5250	49%	7	1323	4	€ 6,500	€ 11,413	57%	€ 1,500	€ 302,000	€ 349,000	2%	4300	€ 3,020,000	€ 800	€ 195,300	€ 50	€ 215,000
6930	4190	60%	6						€ 2,400	€ 324,000	€ 300,000	2%	2800	€ 3,240,000	€ 1,200	€ 187,200	€ 70	€ 196,000
36000	21800	61%	6	14890	1	€ 2,700	€ 3,942	68%	€ 1,700	€ 1,174,000	€ 1,095,000	2%	14400	€ 11,740,000	€ 900	€ 680,700	€ 50	€ 720,000
50100	26900	54%		2303	12	€ 36,952	€ 57,620	64%	€ 2,700	€ 2,654,000	€ 1,250,000	1%	20100	€ 26,540,000	€ 1,400	€ 1,171,200	€ 60	€ 1,206,000
5220	2910	56%	6	256	11	€ 39,453	€ 44,922	88%	€ 2,300	€ 230,000	€ 288,000	3%	2100	€ 2,300,000	€ 1,100	€ 155,400	€ 75	€ 157,500
12000	7350	61%	8	961	8	€ 19,979	€ 27,575	72%	€ 2,300	€ 530,000	€ 467,000	2%	4800	€ 5,300,000	€ 1,200	€ 299,100	€ 65	€ 312,000
16900	10600	63%	3	697	15	€ 40,603	€ 64,419	63%	€ 2,700	€ 898,000	€ 363,000	1%	6800	€ 8,980,000	€ 1,400	€ 378,300	€ 60	€ 408,000
14300	9500	66%	5	6964	1	€ 3,791	€ 5,528	69%	€ 2,700	€ 770,000			5800	€ 7,700,000	€ 1,400	€ 231,000	€ 40	€ 232,000
6310	4070	65%	4	155	26	€ 164,516	€ 169,032	97%	€ 4,200	€ 524,000	€ 233,000	1%	2600	€ 5,240,000	€ 2,100	€ 227,100	€ 90	€ 234,000
11100	6130	55%	8	707	9	€ 23,197	€ 31,966	73%	€ 2,100	€ 452,000	€ 298,000	1%	4500	€ 4,520,000	€ 1,100	€ 225,000	€ 50	€ 225,000
13200	6730	51%	13	3241	2	€ 6,695	€ 9,627	70%	€ 2,400	€ 624,000	€ 574,000	2%	5300	€ 6,240,000	€ 1,200	€ 359,400	€ 70	€ 371,000
20100	12500	62%	13	4170	3		€ 9,568		€ 2,000	€ 798,000	€ 1,572,000	4%	8100	€ 7,980,000	€ 1,000	€ 711,000	€ 90	€ 729,000
5320	3520	66%	4	156	23	€ 56,410	€ 82,051	69%	€ 2,500	€ 256,000	€ 253,000	2%	2200	€ 2,560,000	€ 1,200	€ 152,700	€ 70	€ 154,000
10200	6280	62%	3	298	21	€ 44,295	€ 63,087	70%	€ 1,900	€ 376,000			4100	€ 3,760,000	€ 1,000	€ 112,800	€ 30	€ 123,000
29900	17100	57%	6	1050	16	€ 41,524	€ 59,524	70%	€ 2,100	€ 1,250,000	€ 1,739,000	3%	12000	€ 12,500,000	€ 1,100	€ 896,700	€ 75	€ 900,000
7760	4430	57%	4	49	90	€ 453,061	€ 642,857	70%	€ 4,100	€ 630,000	€ 575,000	2%	3200	€ 6,300,000	€ 2,000	€ 361,500	€ 115	€ 368,000
2680	1920	72%	2	65	30	€ 63,077	€ 72,308	87%	€ 1,800	€ 94,000	€ 110,000	2%	1100	€ 940,000	€ 900	€ 61,200	€ 60	€ 66,000
5650	3520	62%	4	308	11	€ 20,455	€ 28,571	72%	€ 1,600	€ 176,000			2300	€ 1,760,000	€ 800	€ 52,800	€ 25	€ 57,500
35300	20900	59%	8	3260	6	€ 16,564	€ 23,282	71%	€ 2,200	€ 1,518,000	€ 1,351,000	2%	14200	€ 15,180,000	€ 1,100	€ 860,700	€ 65	€ 923,000
13300	8580	65%	6	1584	5	€ 14,141	€ 16,414	86%	€ 2,000	€ 520,000	€ 530,000	2%	5400	€ 5,200,000	€ 1,000	€ 315,000	€ 60	€ 324,000
20500	12100	59%	4	4989	2		€ 10,804		€ 2,700	€ 1,078,000	€ 904,000	2%	8200	€ 10,780,000	€ 1,400	€ 594,600	€ 75	€ 615,000
70300	46900	67%	5	4830	10	€ 24,886	€ 38,571	65%	€ 2,700	€ 3,726,000	€ 4,671,000	3%	28200	€ 37,260,000	€ 1,400	€ 2,519,100	€ 90	€ 2,538,000
19436	11603	61%	6	2920		€ 51,833	€ 64,664	72%	€ 2,350	€ 878,250	€ 895,500	2%	7821	€ 8,782,500	€ 1,362	€ 498,600	€ 64	€ 512,854
5000	2040	41%	4	270	8	€ 18,148	€ 27,407	66%	€ 1,500	€ 148,000	€ 208,000	3%	2000	€ 1,480,000	€ 800	€ 106,800	€ 55	€ 110,000
4770	2190	46%	4	354	6	€ 12,147	€ 18,644	65%	€ 1,400	€ 132,000	€ 175,000	3%	2000	€ 1,320,000	€ 700	€ 92,100	€ 50	€ 100,000
49400	23600	48%	12	800	30		€ 24,125		€ 400	€ 386,000	€ 2,313,000	12%	19800	€ 3,860,000	€ 200	€ 809,700	€ 45	€ 891,000
13800	8380	61%	3					95%	€ 600	€ 160,000	€ 55,000	1%	5600	€ 1,600,000	€ 300	€ 64,500	€ 15	€ 84,000
8900	5800	65%	2	1240	5		€ 11,935		€ 1,700	€ 296,000			3600	€ 2,960,000	€ 900	€ 88,800	€ 25	€ 90,000
4800	3020	63%	2	7820	0		€ 1,471		€ 2,400	€ 230,000			2000	€ 2,300,000	€ 1,200	€ 69,000	€ 35	€ 70,000
26000	15800	61%	11	2515	6	€ 11,173	€ 15,109	74%	€ 1,500	€ 760,000	€ 1,043,000	3%	10400	€ 7,600,000	€ 800	€ 540,900	€ 55	€ 572,000
1730	780	45%	3	500	2	€ 4,600	€ 5,600	82%	€ 1,700	€ 56,000	€ 534,000	19%	700	€ 560,000	€ 800	€ 177,000	€ 255	€ 178,500
10800	7660	71%	11	548	14	€ 20,073	€ 26,460	76%	€ 1,400	€ 290,000	€ 609,000	4%	4400	€ 2,900,000	€ 700	€ 269,700	€ 65	€ 286,000
1730	870	50%	5					85%	€ 800	€ 26,000	€ 55,000	4%	700	€ 260,000	€ 400	€ 24,300	€ 35	€ 24,500
12693	7014	55%	6	1405		€ 13,228	€ 16,344	78%	€ 1,400	€ 248,400	€ 624,000	6%	5200	€ 2,484,000	€ 1,000	€ 224,300	€ 64	€ 240,600
15817	9314	60%	6	2154		€ 42,712	€ 49,291	74%	€ 2,100	€ 626,200	€ 725,100	3%	6400	€ 6,261,100	€ 1,300	€ 376,800	€ 61	€ 390,211

Facade-related costs

Facade construction
20% of construction costs

Mechanical installations
10% of construction costs

Related operation costs
30% of operation costs



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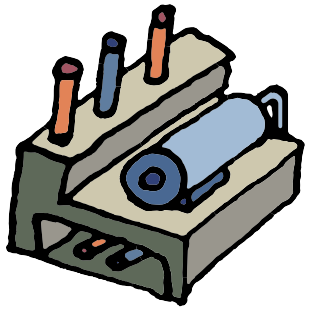

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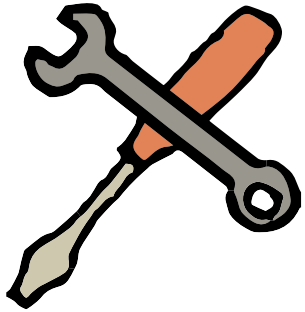

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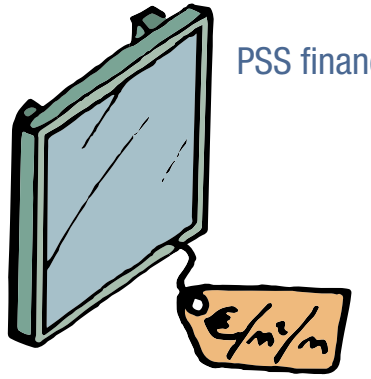


PSS financing / m² / year
Avg = € 65 / m²
Max = € 115 / m²
Min = € 30 / m²

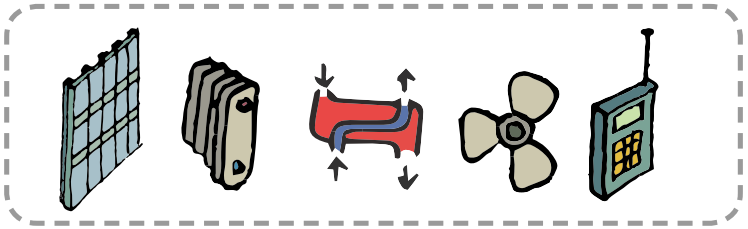
Initial Investments

Yearly costs

Notes: 4 Cost model: Office design
2004 issue 49 | By Davis Langdon & Everest

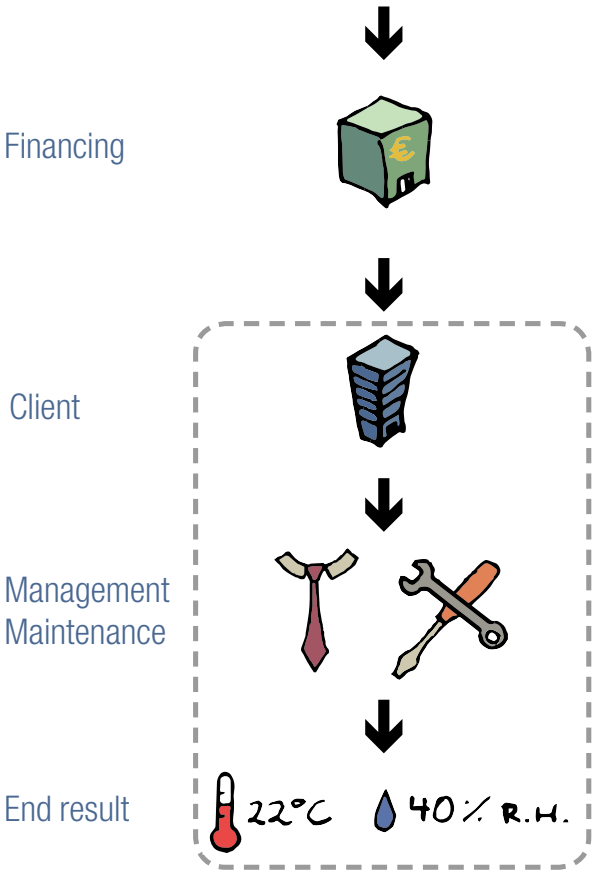
Traditional purchase or leasing

Financing and managing of technological products to obtain a range of final results



Building climate technologies

Facade
Heating
Heat exchange
Ventilation
Automated control



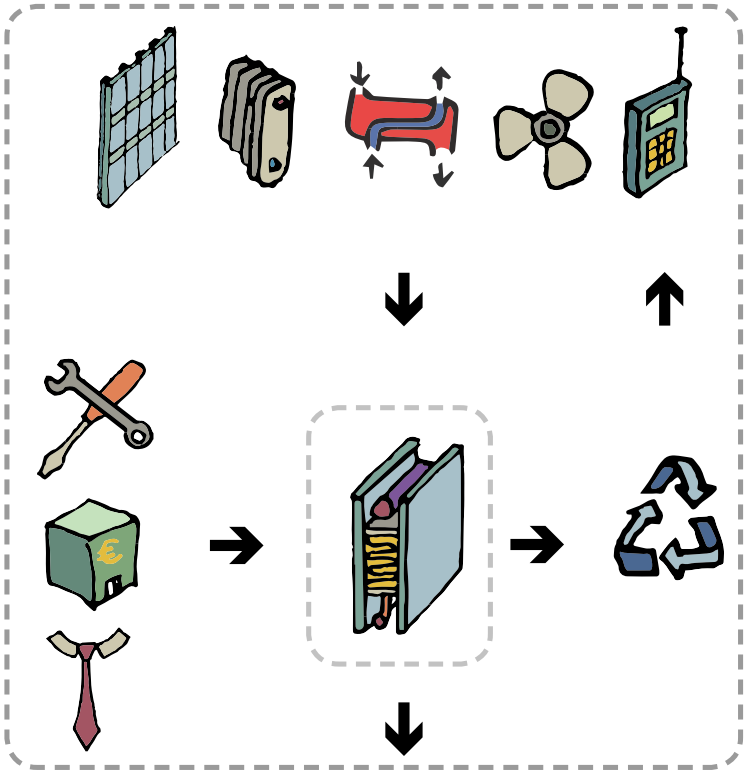
What would a PSS-modeled facade provider do?

Product-Service System

Bundled products and services based on final result

Building climate technologies

Facade
Heating
Heat exchange
Ventilation
Automated control

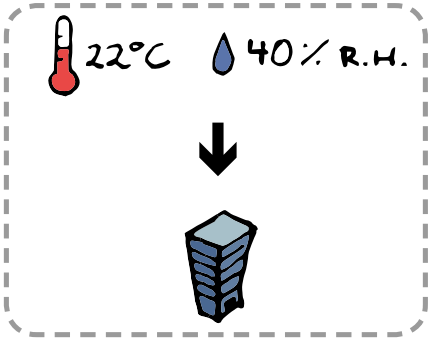


Central control

- Financial, management and maintenance services
- Technological hardware and software
- Material ownership and recycling

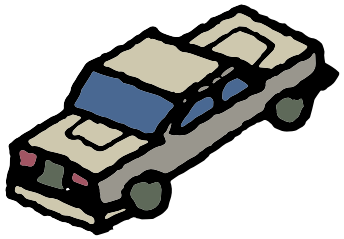
Service delivery

- End result is fixed
- Client avoids responsibility and risk management

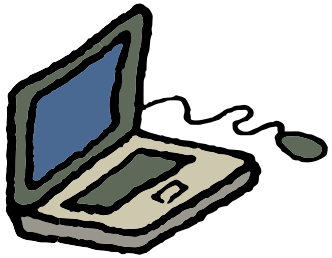


Xerox model

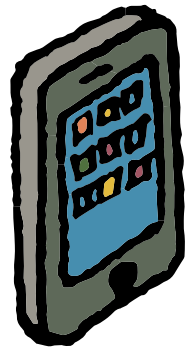
UK Car Hire



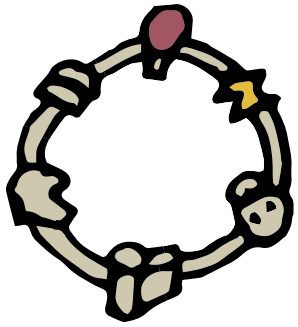
Technological leasing



Telecommunications



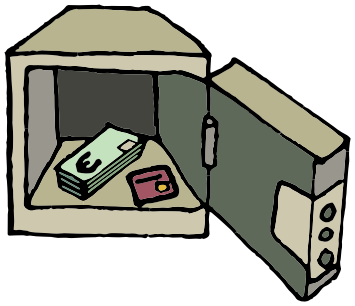
Pandora bracelet



	AT&T phone + plan (Purchase)	AT&T 2 year (Leasing)	AT&T Next (PSS)
Initial cost	$ 649.00	$ 199.00	$ -
Monthly financial cost	$ -	$ -	$ 25.00
Plan costs	$ 20.00	$ 60.00	$ 45.00
Total (24 month term)	$ 1,129.00	$ 1,639.00	$ 1,680.00

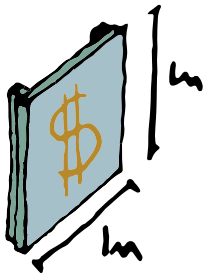
* iPhone 5c 16gb
Unlimited call + text
300mb data
www.att.com, 2014

Disadvantages of purchasing



Locks
Cash and credit resources

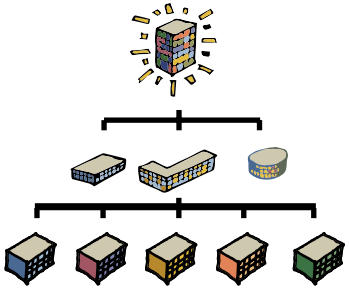
End-of-life
Is no-one's responsibility



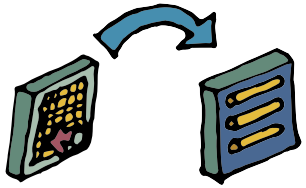
Functional Cycle
Is tied to investment return

Advantages of a PSS

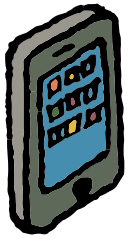
Capital investment
Significantly reduced



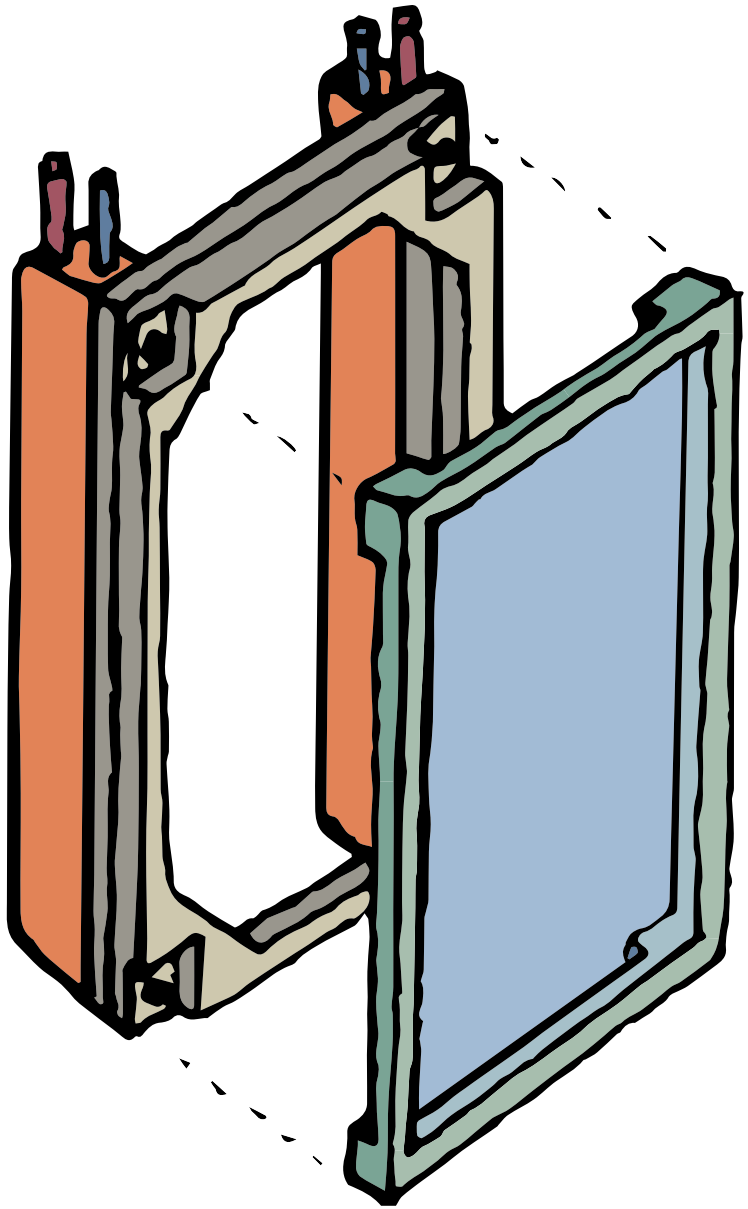
Building portfolio
Asset swapping, extends material cycles



Renovation / Upgrade
Is in the service provider's best interest



Branding
Is based not on form but on customization, personalization and flexibility



2. Schematic service scenarios

TU Delft

3mE Building

4 main volumes and connecting bridges

Structural
Support layer

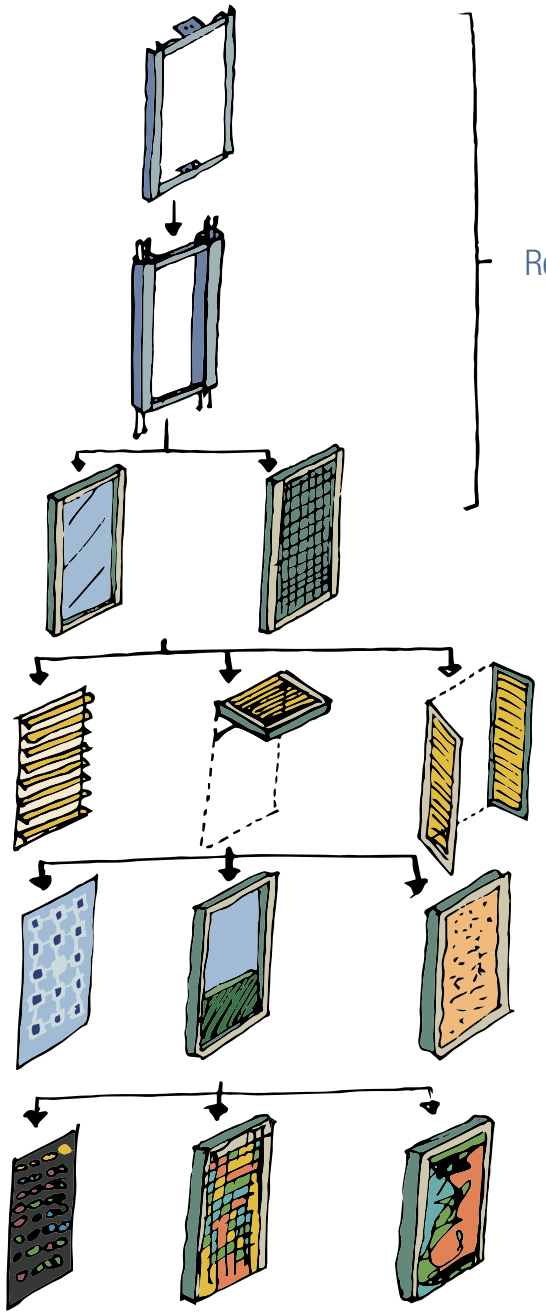
Mechanical
Installations and systems

Performative
Watertightness and appearance

Solar Shading
Fixed or adaptable

Energy
Generation / Storage

Media
Sponsorship / Informative

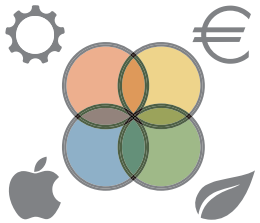


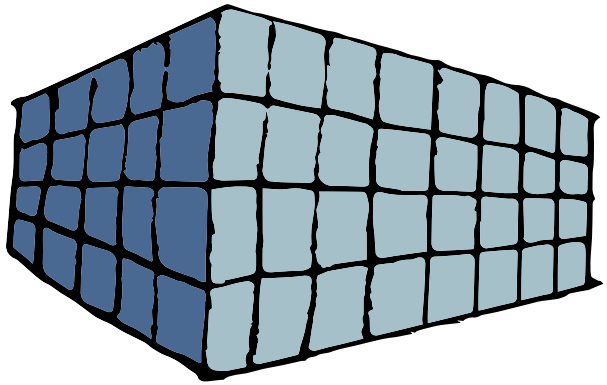
Base Systems
Required initial investment
Longer term contract

Add-on's
Shorter term upgrades for strategic flexibility
Modular interchangeability throughout building portfolio

Unit catalogue

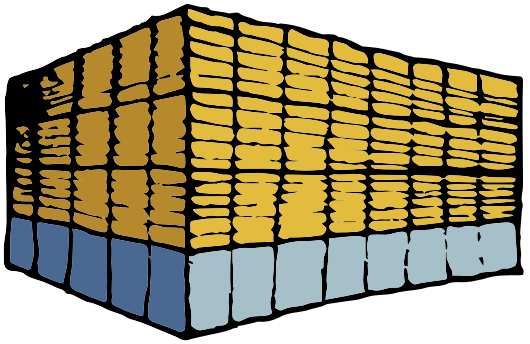
Would expand through time as new technologies become available, older units become cheaper and stocks of second-hand panels vary.



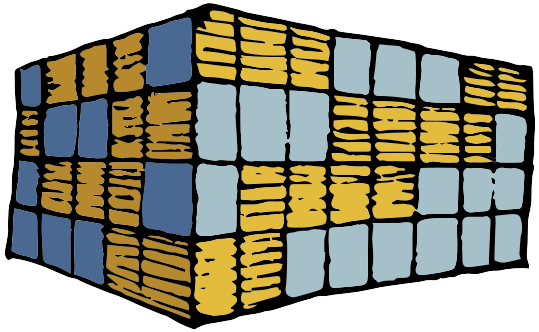


Basic Configuration

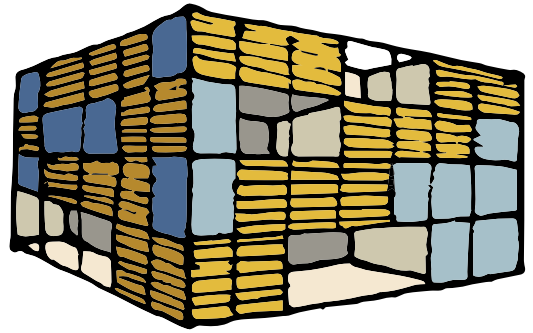
→ Image-based upgrade

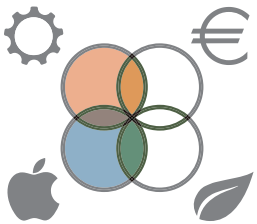


→ User-based upgrade

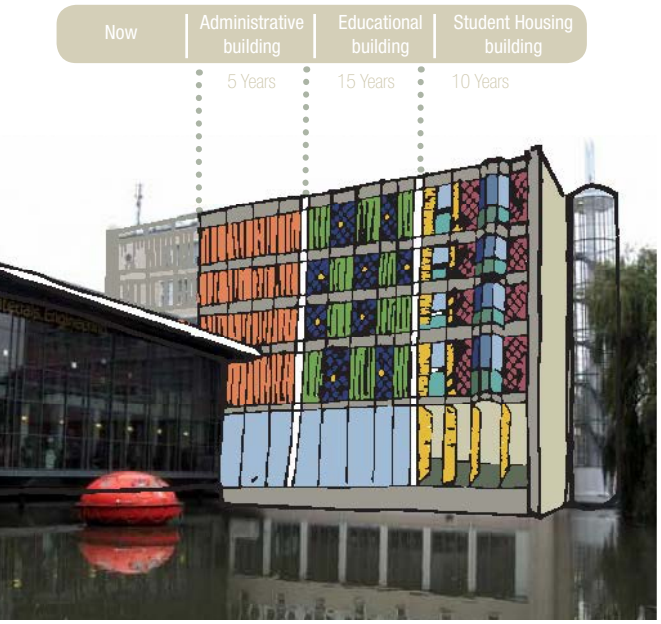


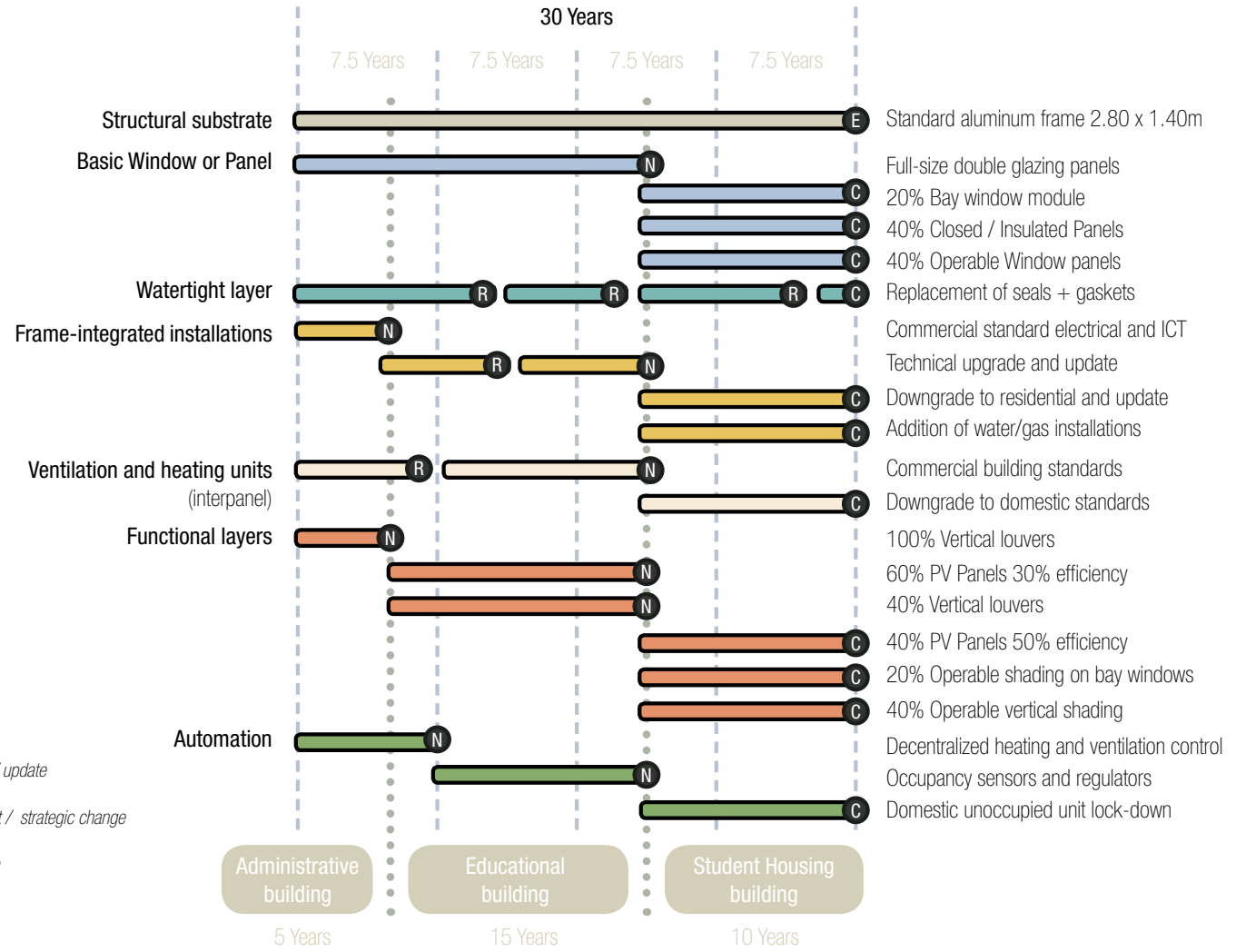
→ Space-based upgrade



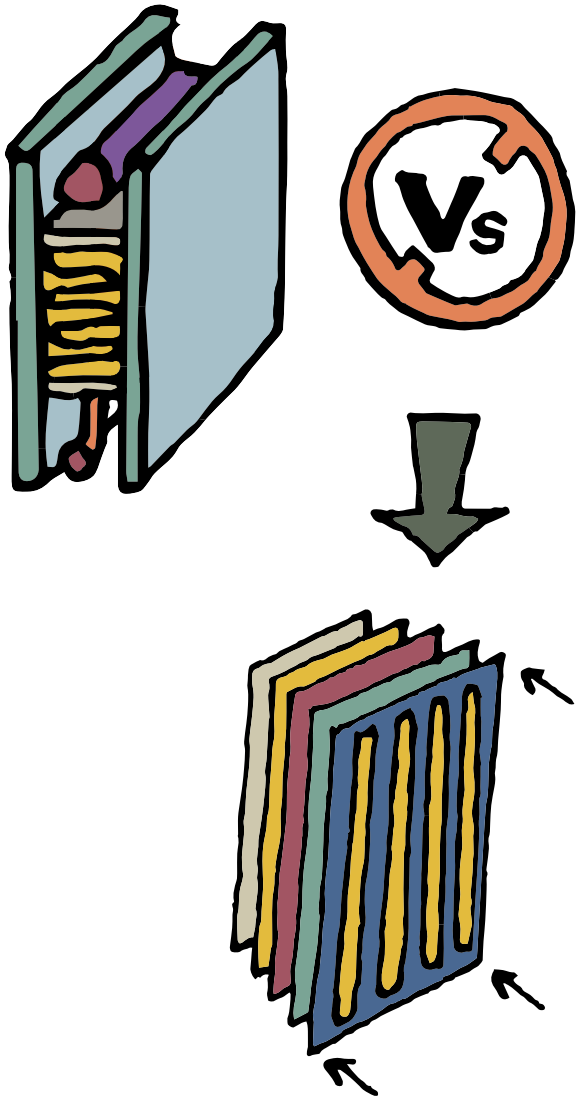


Façade Leasing | Applied scenarios_ Client-based upgrades



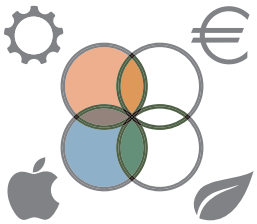


Centralized management
A service-based business-to-client relation would promote innovation and integration of latest technologies towards a more energy and cost efficient delivery.

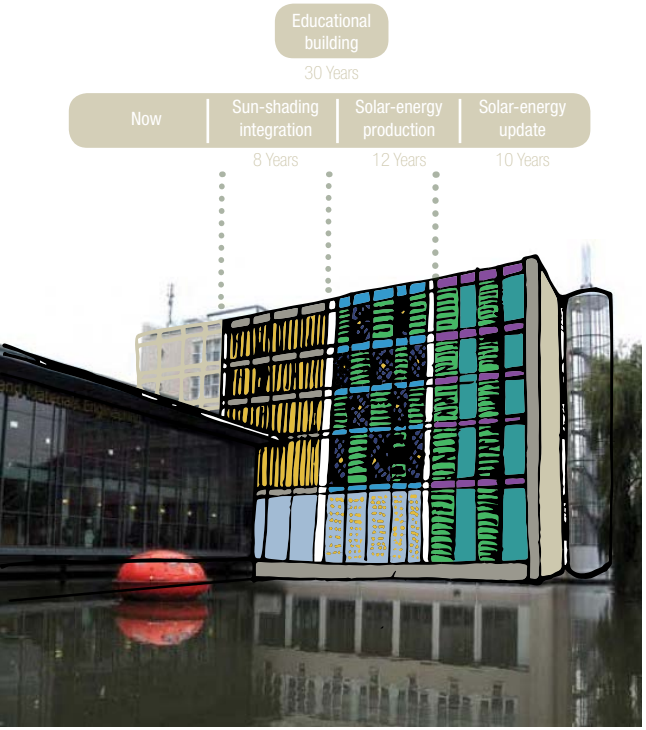


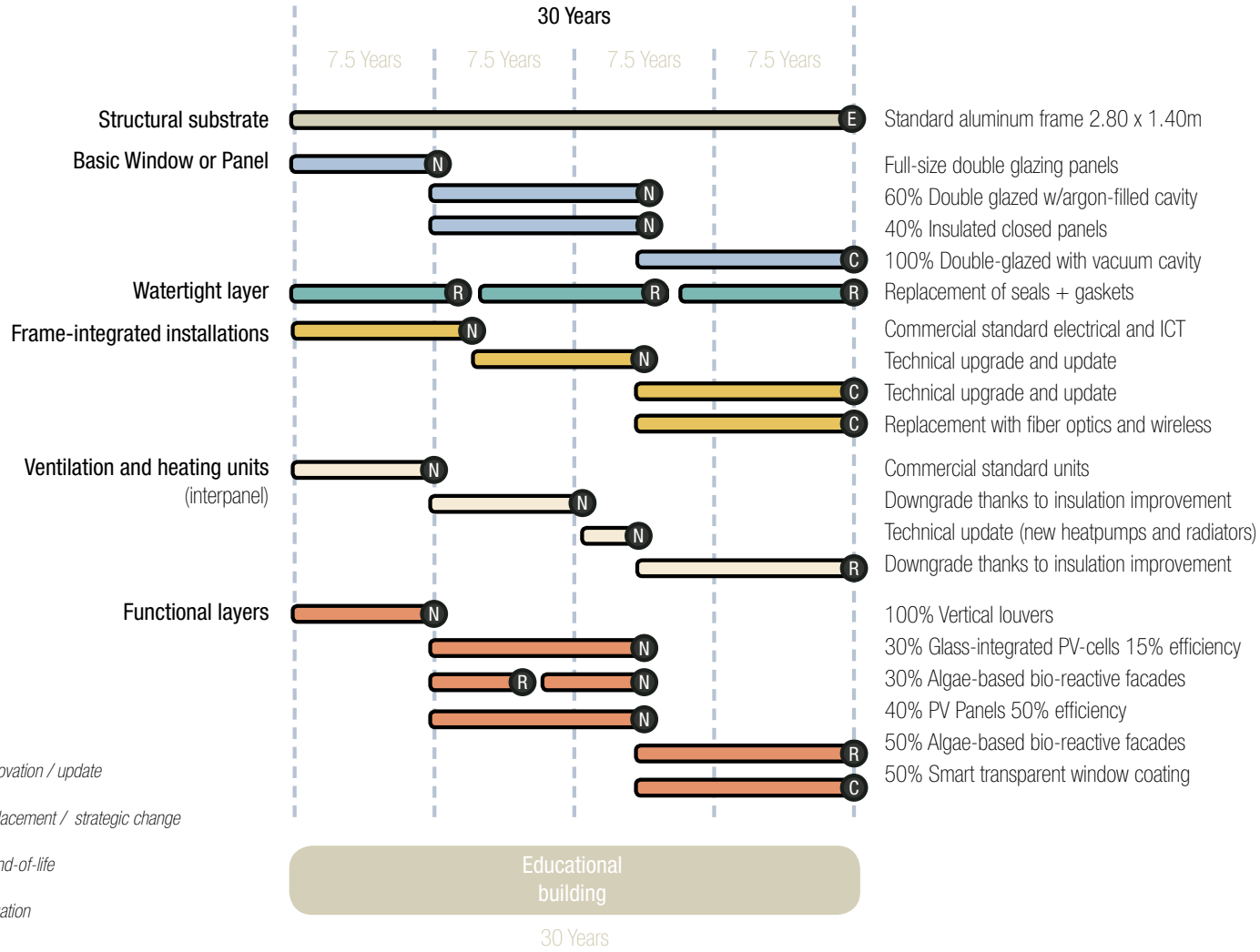
New Technologies
Would normally displace existing ones as they become obsolete or no longer cost-effective

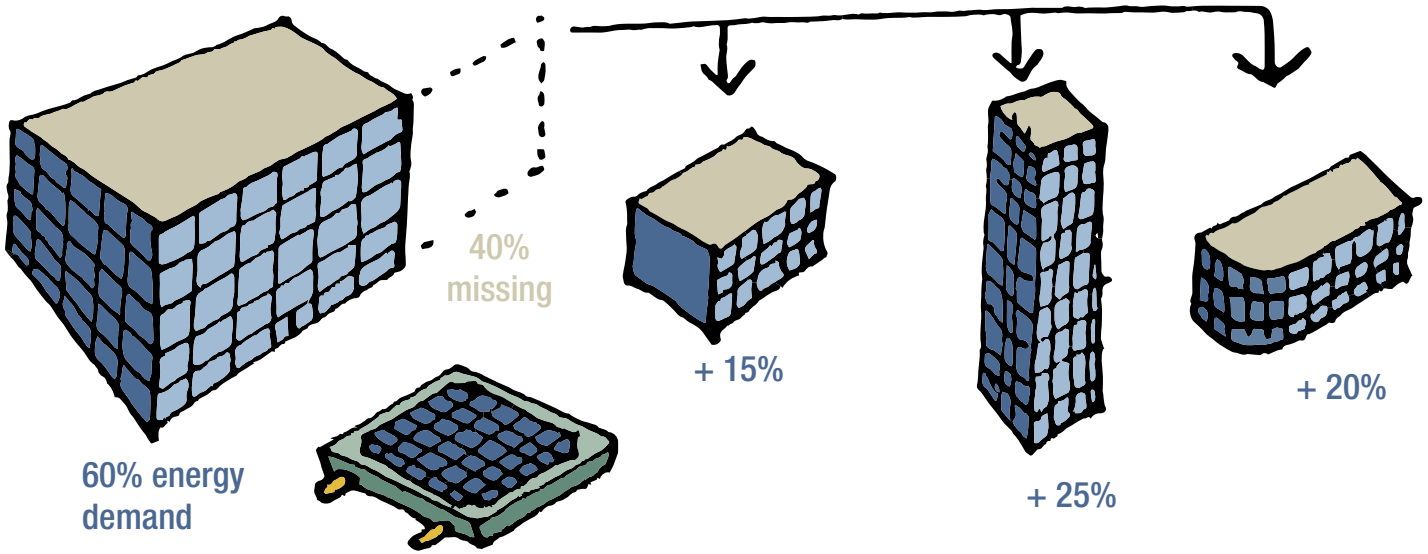
Modular Integration
Allows new technologies and emerging systems to be absorbed into the catalogue and immediately available to the client-base



Façade Leasing | Applied scenarios_ Service-provider based

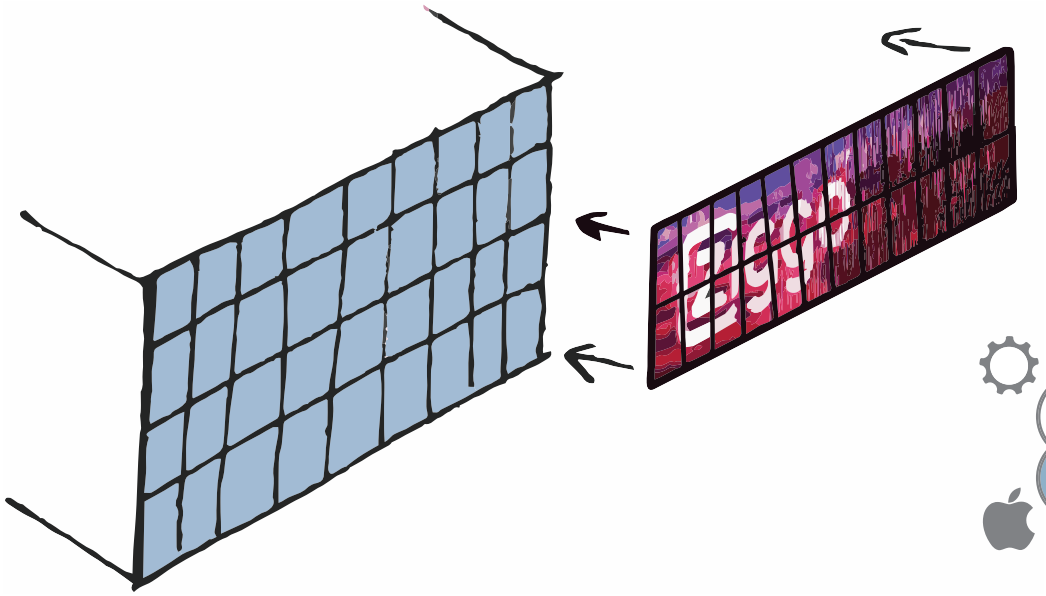




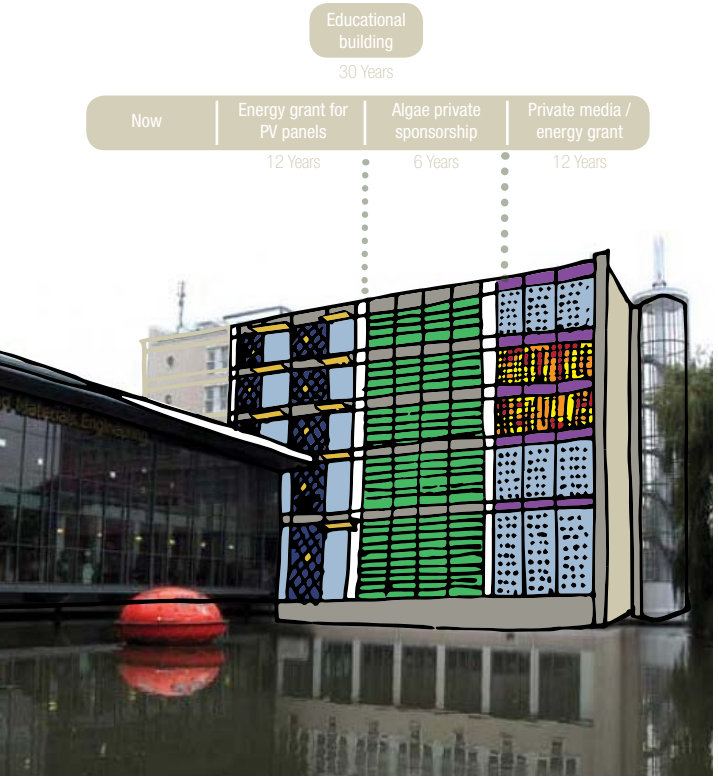


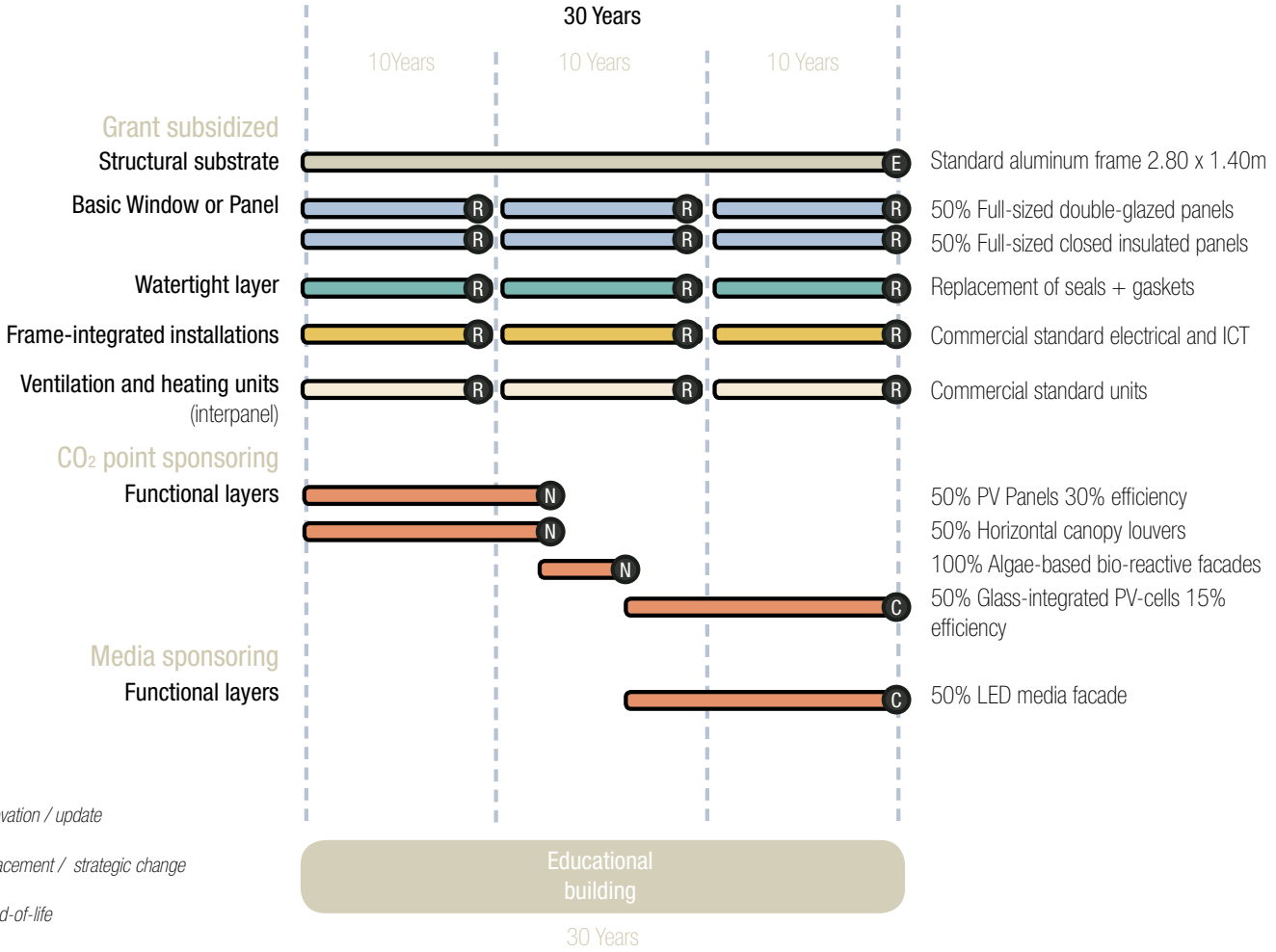
CO2 Point Acquisition
- Building energy neutrality. Installing cost-effective add-on's through grants.
- Energy point exchange between properties.

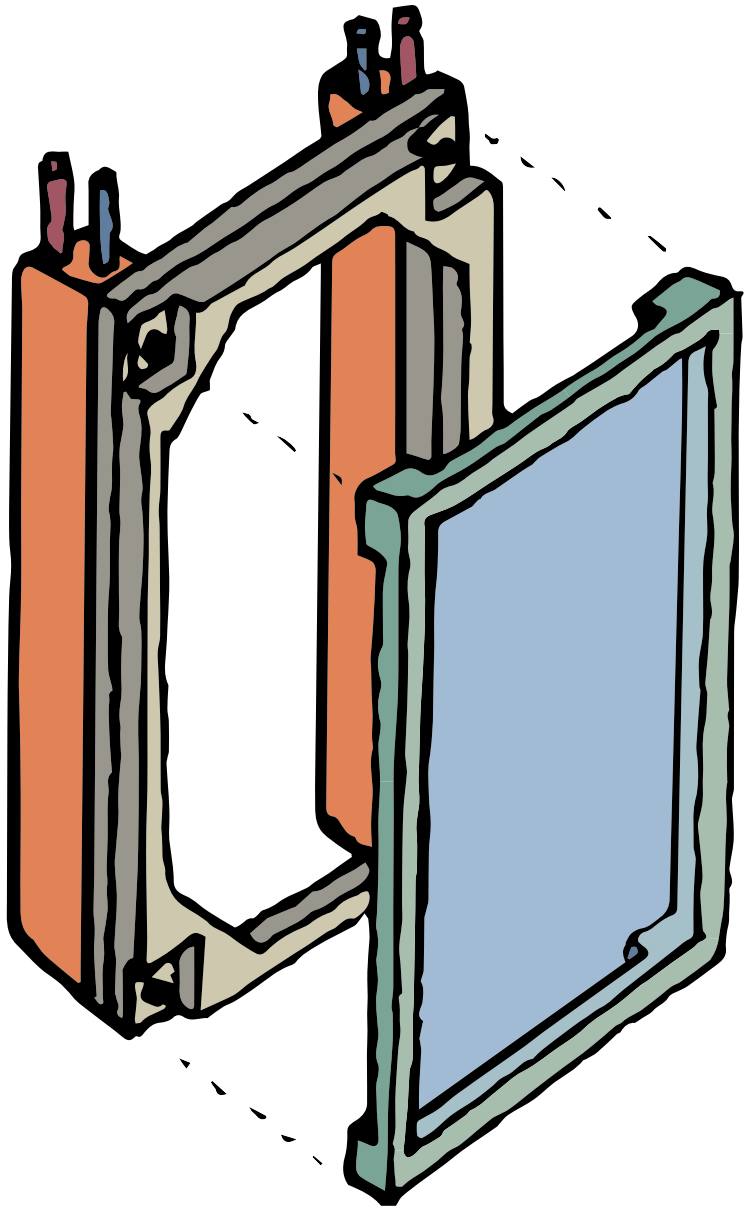
120% total
energy sponsored



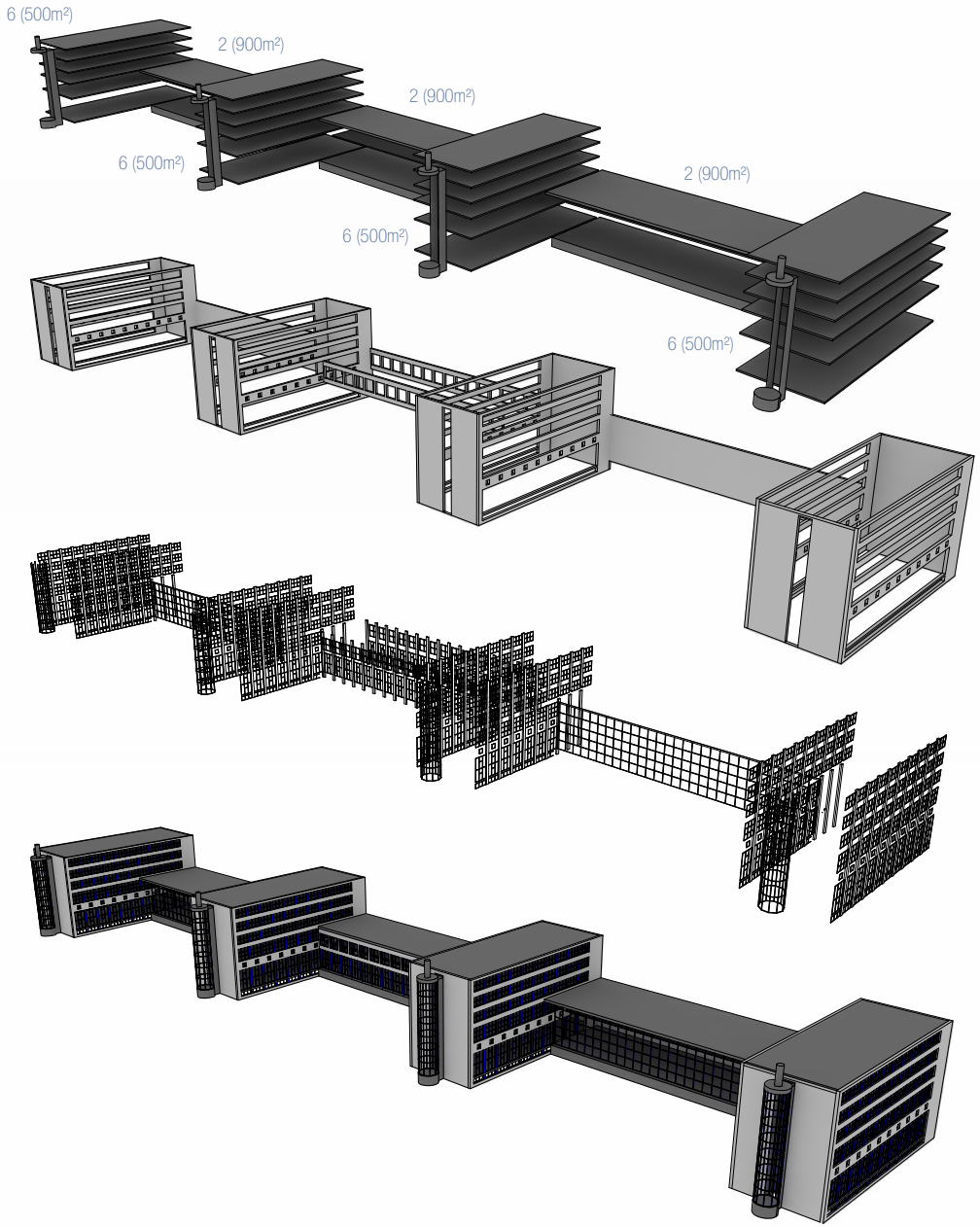
Marketing or information
- Third parties or tenants can sponsor media or showcase add-on's by paying only for the installation fees and month to month (additional) expense.
- Reducing initial sponsor capital investment.


Educational building
30 Years
Now
Energy grant for PV panels
Algae private sponsorship
Private media / energy grant
12 Years
6 Years
12 Years


30 Years
10Years
10 Years
10 Years
Grant subsidized
Structural substrate
Standard aluminum frame 2.80 x 1.40m
Basic Window or Panel
50% Full-sized double-glazed panels
50% Full-sized closed insulated panels
Watertight layer
Replacement of seals + gaskets
Frame-integrated installations
Commercial standard electrical and ICT
Ventilation and heating units (interpanel)
Commercial standard units
CO_2 point sponsoring
Functional layers
50% PV Panels 30% efficiency
50% Horizontal canopy louvers
100% Algae-based bio-reactive facades
50% Glass-integrated PV-cells 15% efficiency
Media sponsoring
Functional layers
50% LED media facade
R System renovation / update
N System replacement / strategic change
E Technical End-of-life
C Unit continuation
Educational building
30 Years



3. Case-study and financial model



gfa = (500*6*4)+(900*6) = **17,400m²**

concrete area = (280*8)+(500*3)+(225*6)+130 = **5,780m²**

glass area = (350*6)+(440*2)+(150*4)+1370 = **4,950m²**

3ME Building Parameters		
Sq Meters of Construction		17,400
Sq Meters of Façade		10,730
Floor:Façade Area Ratio		62%
Current Energy Use (kWh/sqm-year)		200
Cost of Energy (kWh)	€	0.214
Current Energy Expense (per year)	€	744,720
Rate of Interest (30 Year Loan)		6%
Rate of Inflation		2%
Rate of Inflation (for energy prices)		7%
Yield of Alternative Investment		8%
PSS Production and Maintenance Costs *(Economy of scale)*		90%
Down Payment (20%)	€	1,277,276
PSS Return On Investment		10%
Maintenance Costs (% of overall costs)		3%
Façade Maintenance Costs (% of maintenance costs)		16.50%

Project information

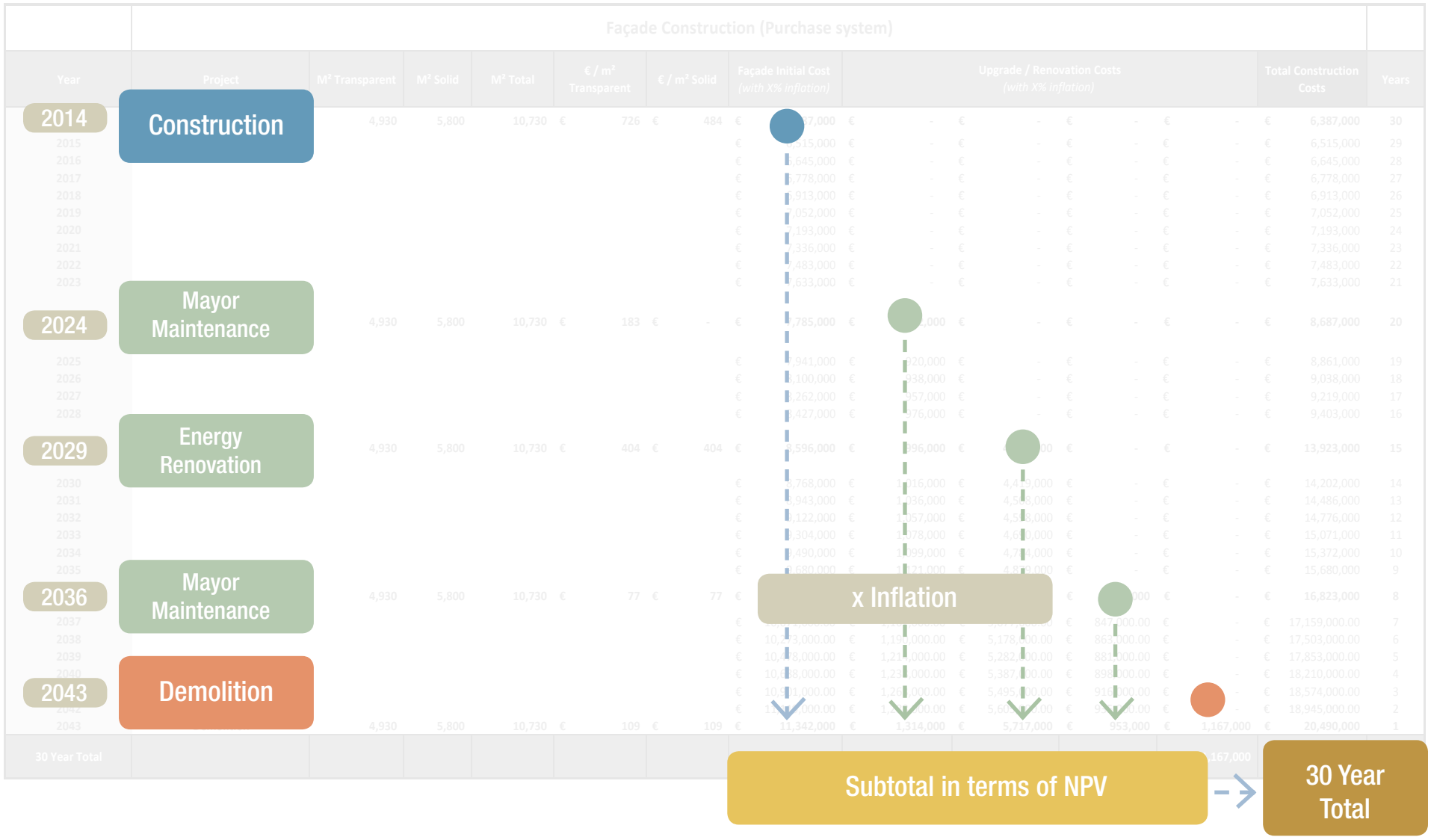
Energy expenses

Financial factors

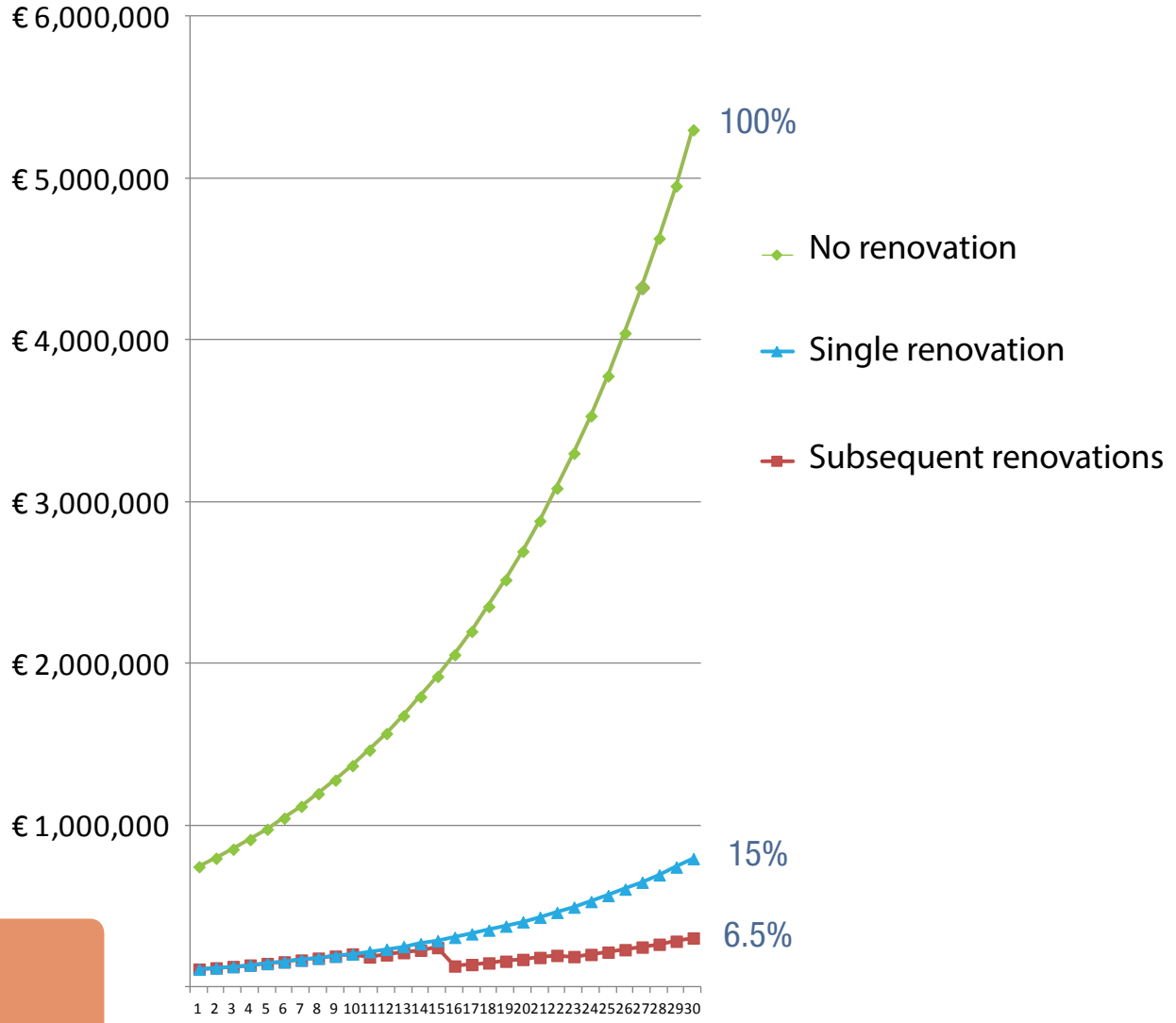
Scenario values

Maintenance costs

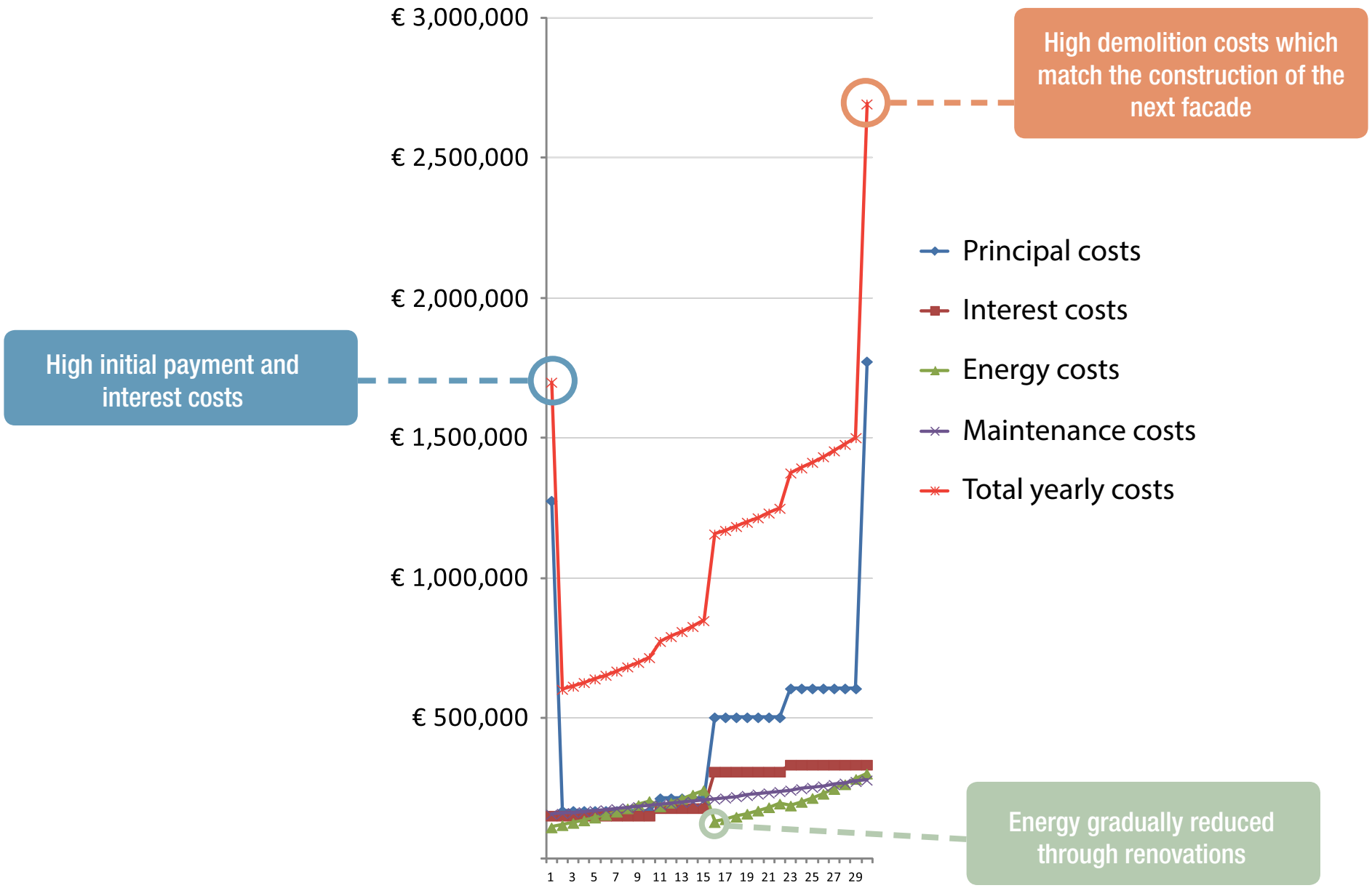
Façade Leasing | Financial model - Construction costs

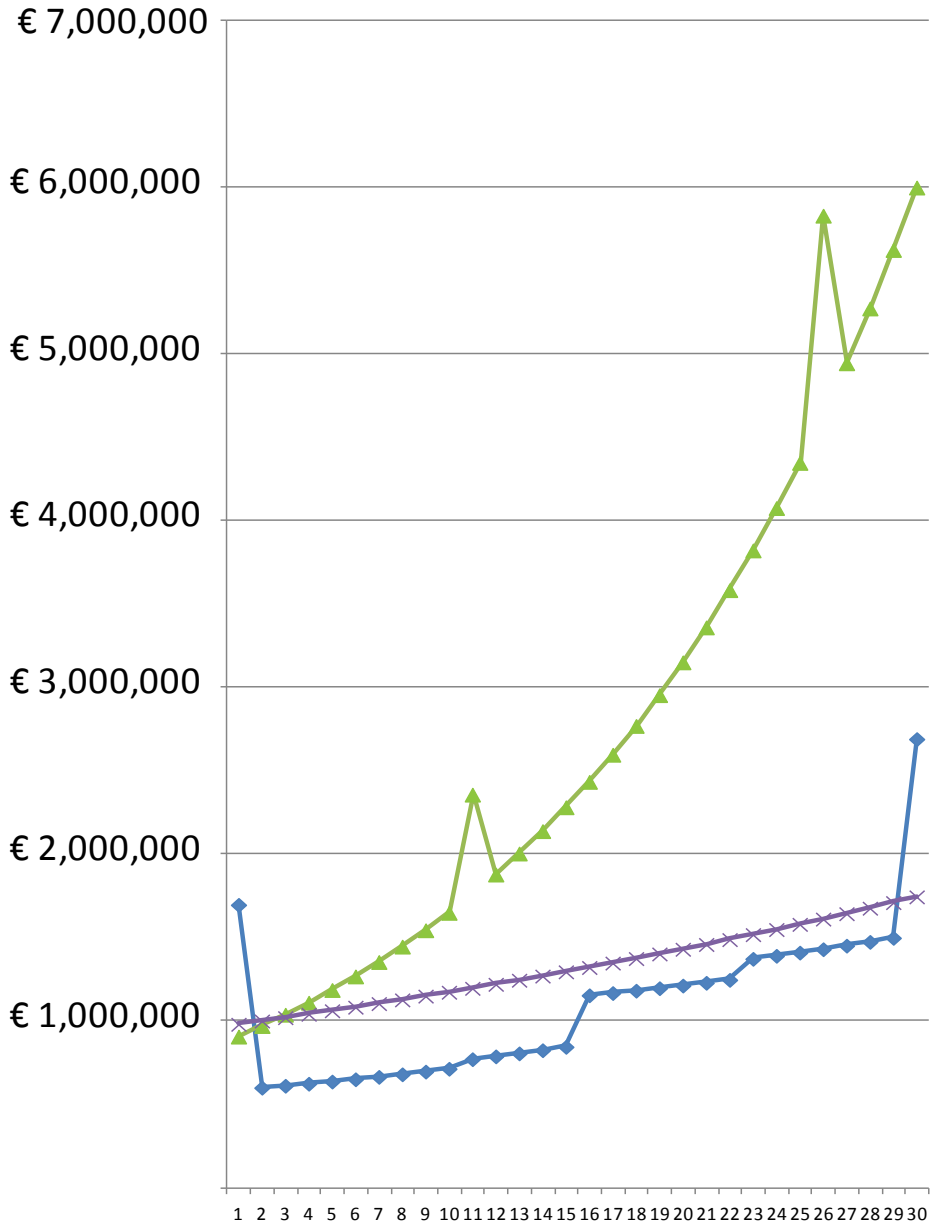


Façade Leasing | **Financial model -** "No Renovation" Model



Construction costs = 0
Energy Costs = 7% increase per year


€ 3,000,000
€ 2,500,000
€ 2,000,000
€ 1,500,000
€ 1,000,000
€ 500,000
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
Principal costs
Interest costs
Energy costs
Maintenance costs
Total yearly costs
High demolition costs which match the construction of the next facade
High initial payment and interest costs
Energy gradually reduced through renovations



Total No Renovation

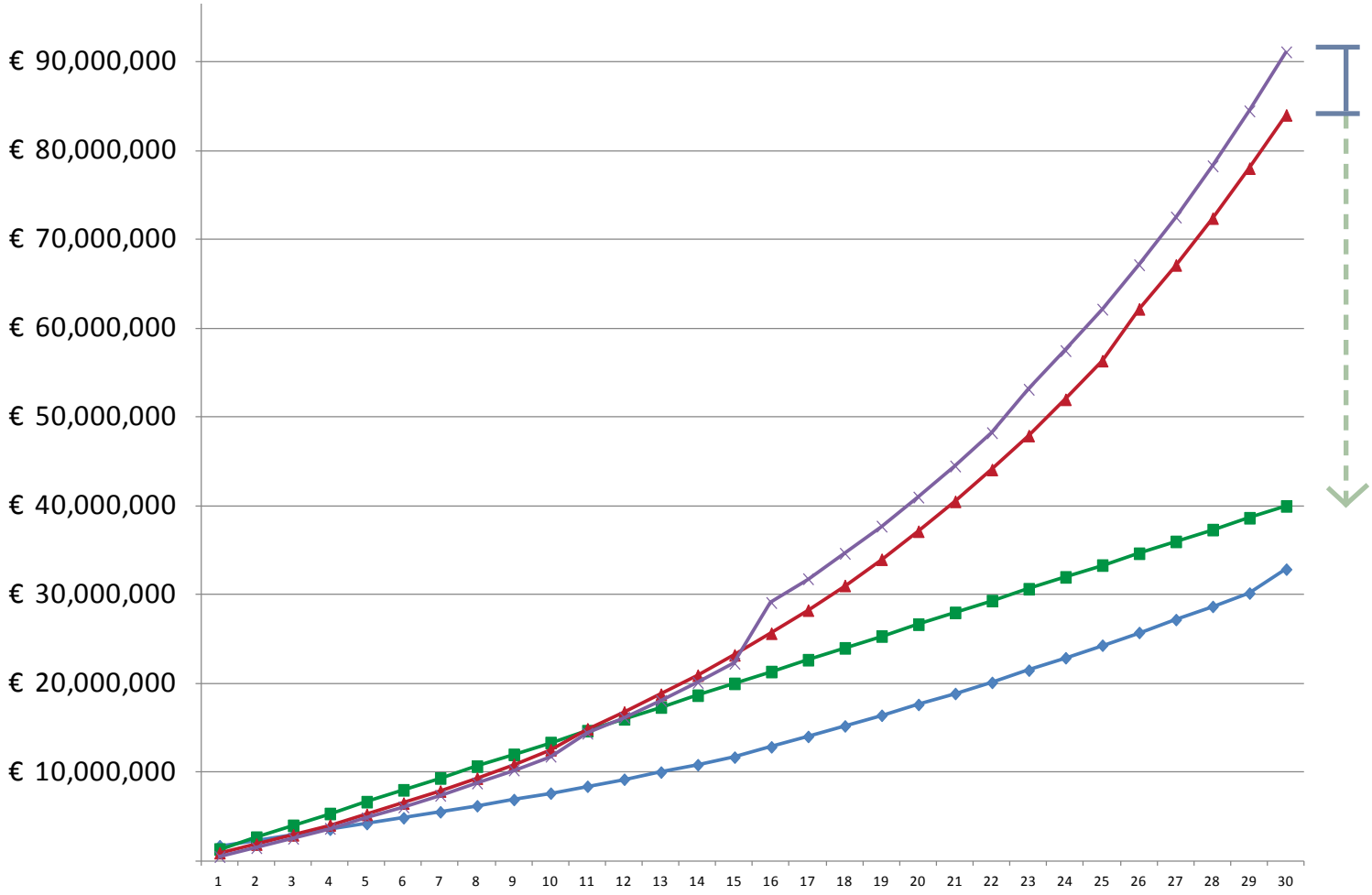
Total Loan Costs :
Capital, Interest, Energy, Maintenance

PSS Service Cost Adjusted to Inflation

1. It requires no initial effort or mayor investment

2. Offers a stable, predictable expense scheme

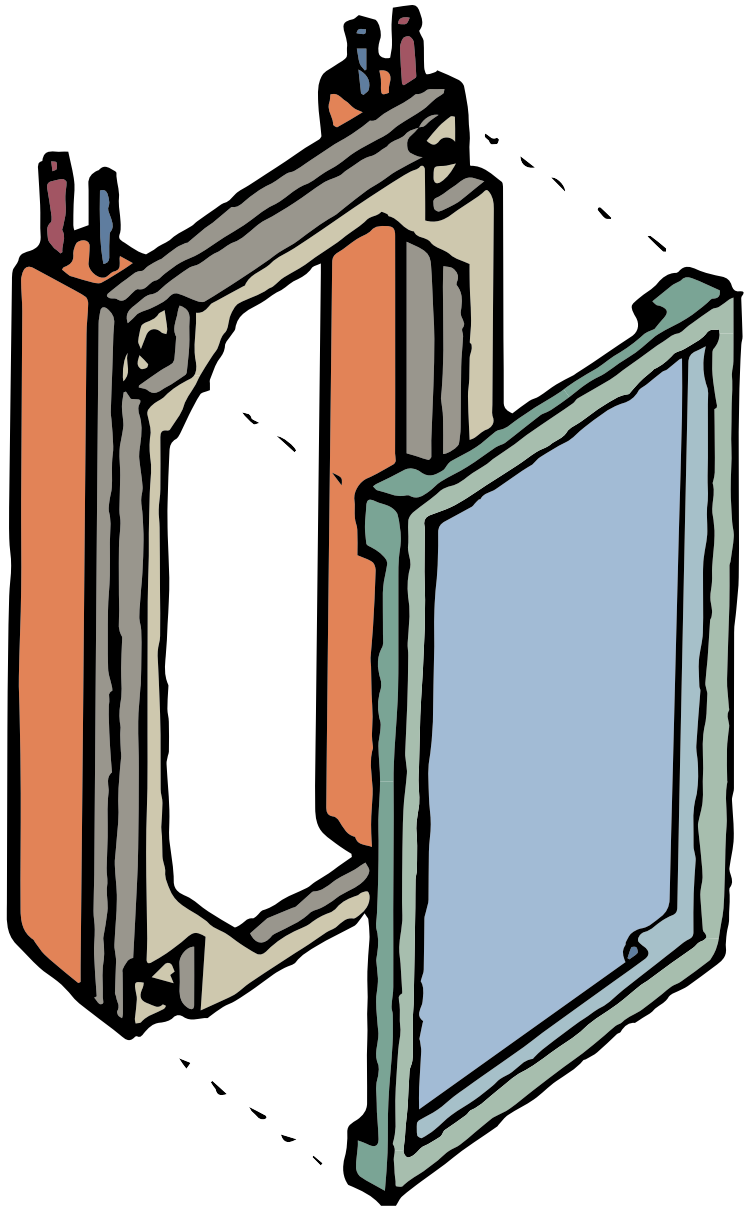
Façade Leasing | **Financial model -** Financial conclusions



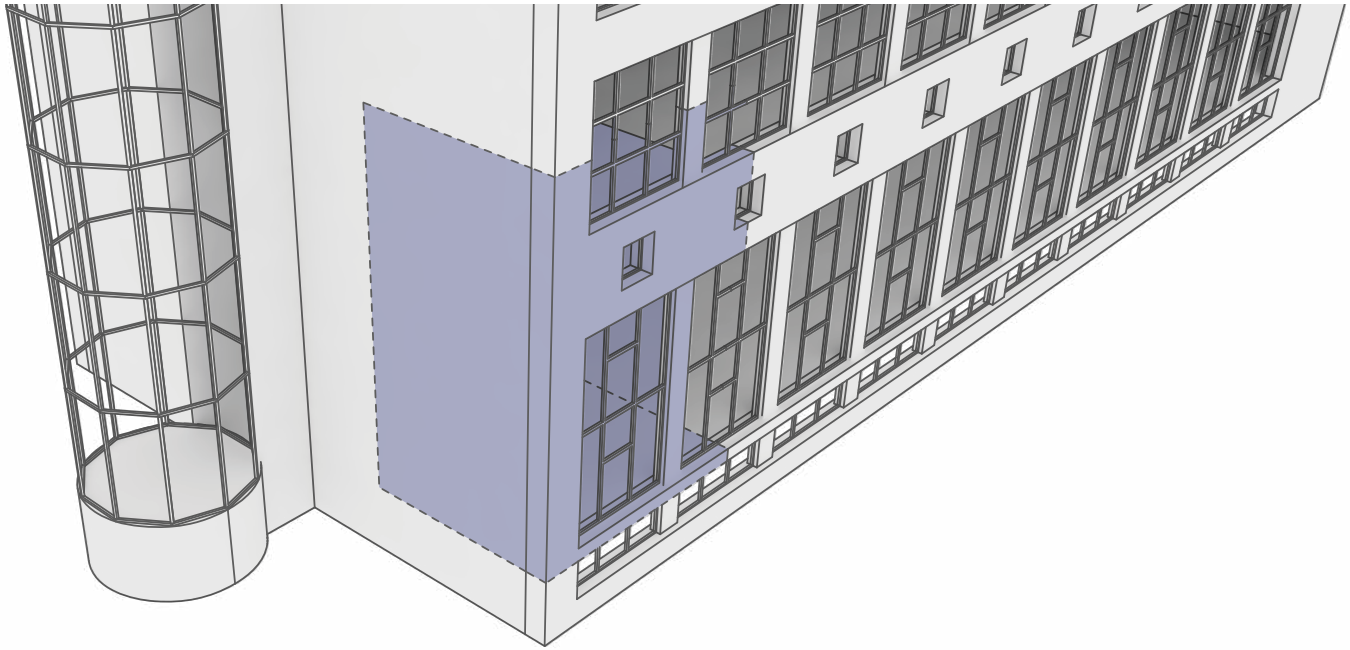
3. Optimizes returns on primary business activities.

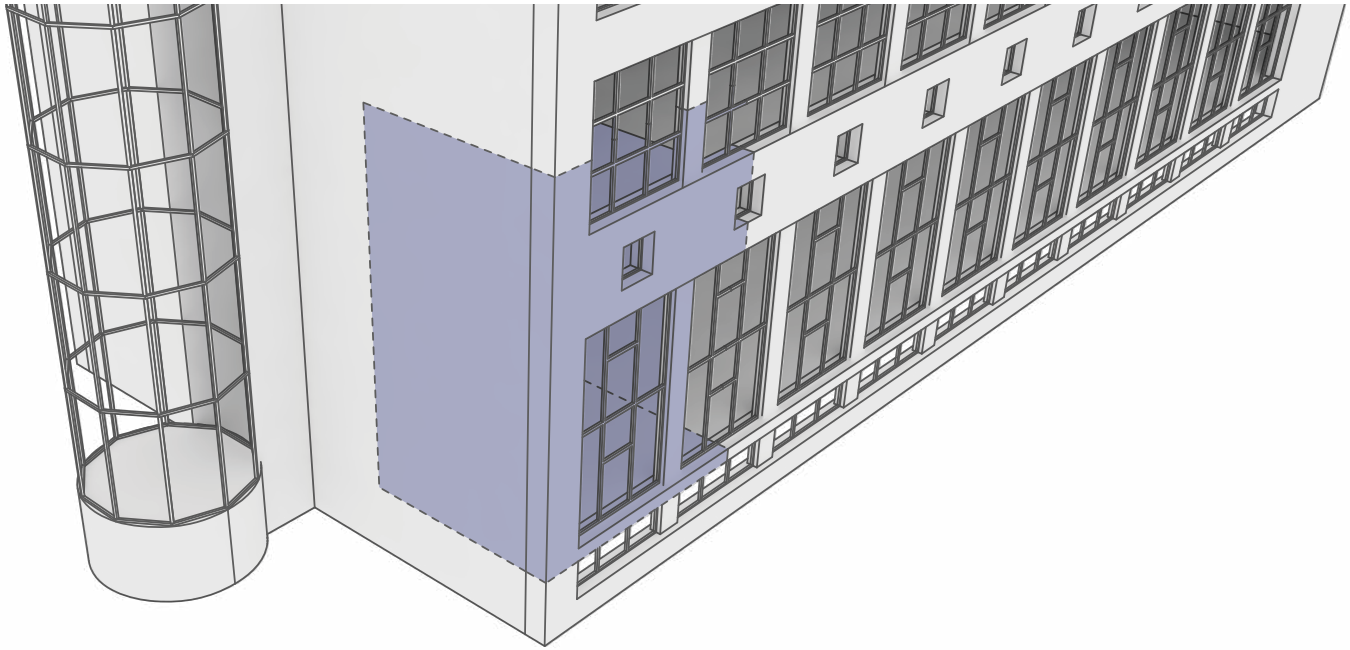
	Construction	Maintenance	Energy	Total	%
Loan	€ 20,734,000.00	€ 6,413,000.00	€ 5,694,000.00	€ 32,839,000.00	39%
Without Renovation	€ -	€ 13,645,000.00	€ 70,347,000.00	€ 83,992,000.00	100%
PSS	€ -	€ -	€ -	€ 39,936,000.00	48%
Alternative Investment	€ 78,984,000.00	€ 13,645,000.00	€ 5,694,000.00	€ 98,322,000.00	117%

4. Cost against traditional model is within an acceptable 22% range.



4. Value-Engineered renovation strategies





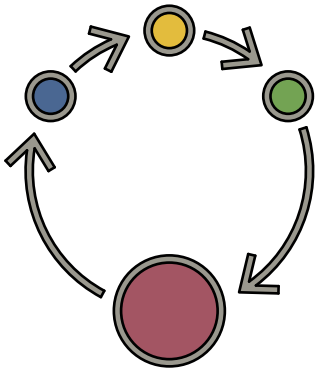
Material strategies

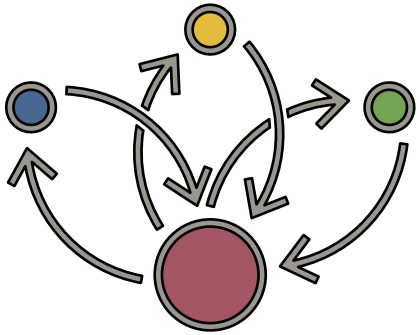
Reusable

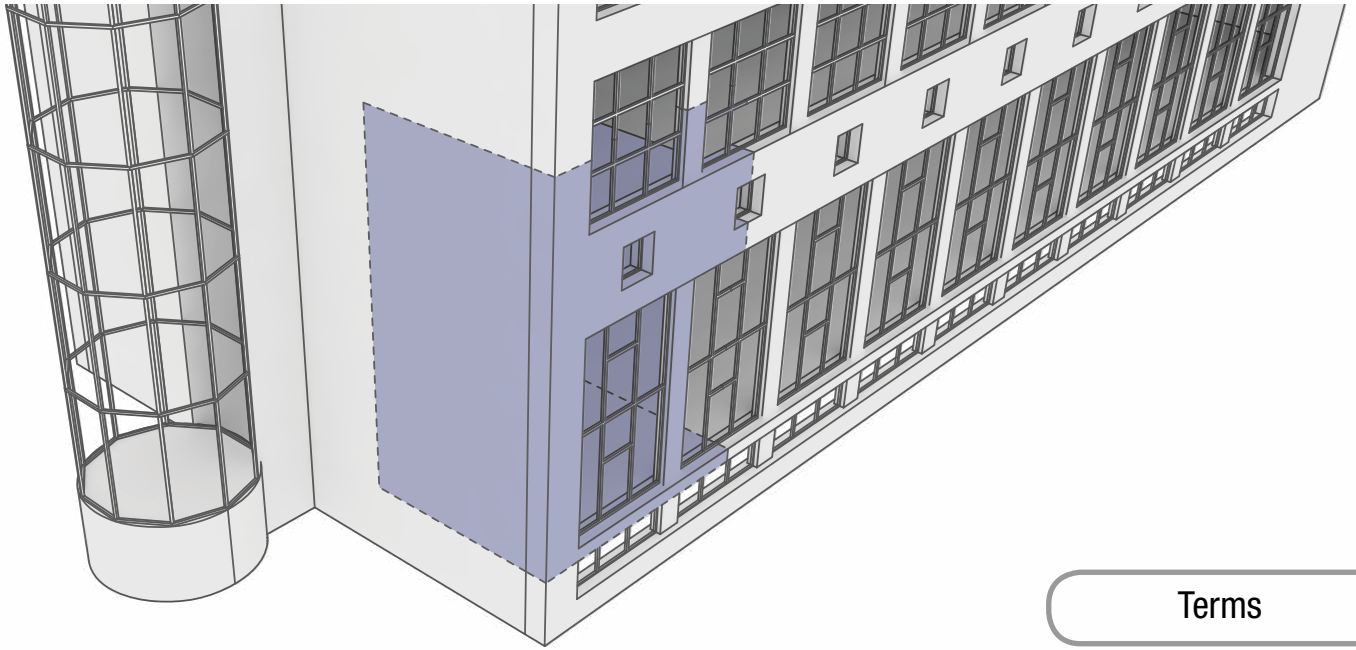
Disposable

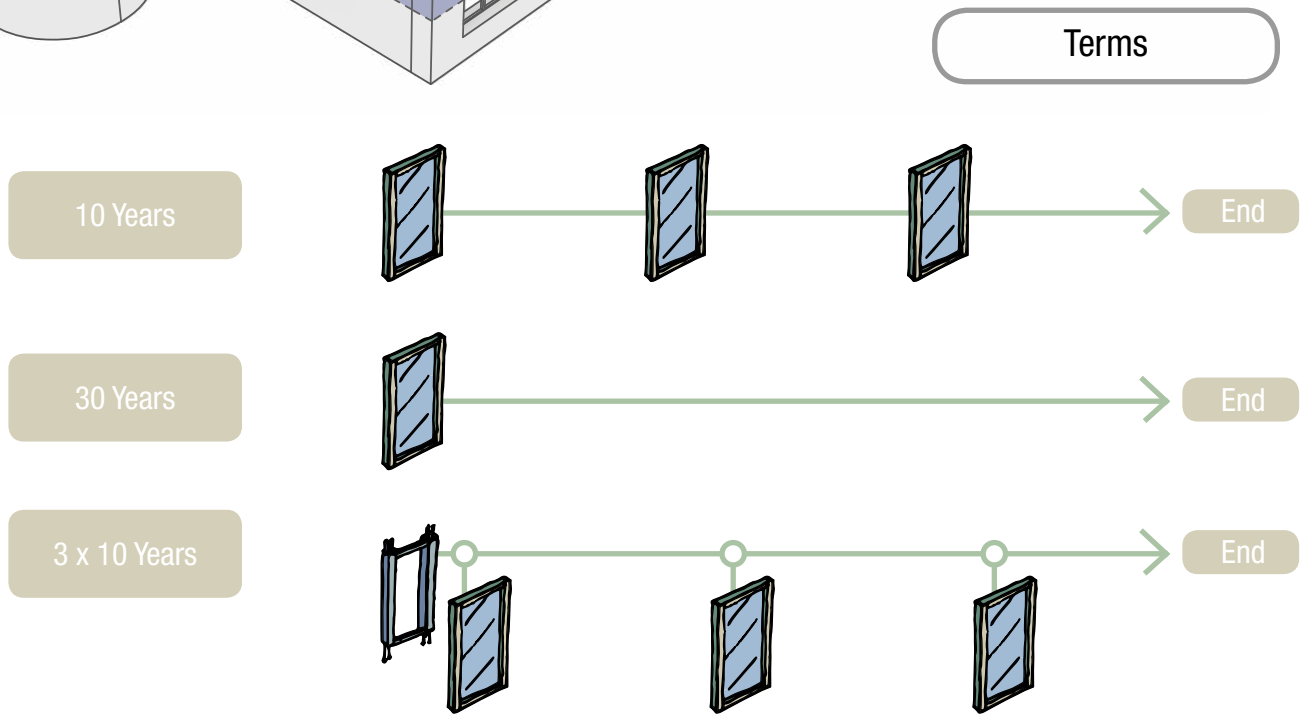
Applications / Users

Manufacturer / Service Provider







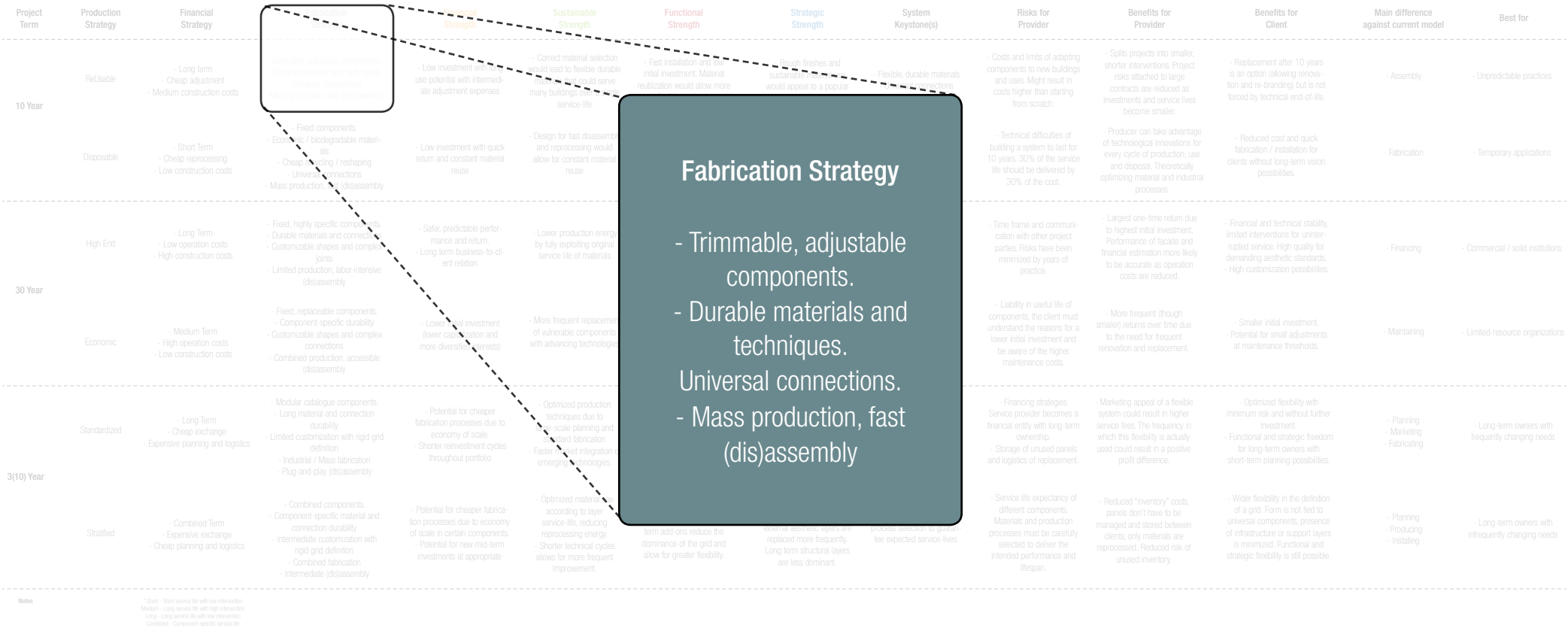

Terms
10 Years
End
30 Years
End
3 x 10 Years
End

Façade Leasing | Renovation strategies - Planning and comparison

				Production			Value strengths					Risks and Benefits			Good for...	
Project Term	**Production Strategy**	**Financial Strategy**	**Fabrication Strategy**	**Financial Strength**	**Sustainable Strength**	**Functional Strength**	**Strategic Strength**	**System Keystone(s)**	**Risks for Provider**	**Benefits for Provider**	**Benefits for Client**	**Main difference against current model**	**Best for**
10 Year	ReUsable	- Long term - Cheap adjustment - Medium construction costs	- Trimmable, adjustable components. - Durable materials and techniques - Universal Connections - Mass production, fast (dis)assembly	- Low investment with long use potential with intermediate adjustment expenses	- Correct material selection would lead to flexible durable materials that could serve many buildings over a single service-life	- Fast installation and low initial investment. Material reutilization would allow more flexible contracts	- Rough finishes and sustainable material use would appeal to a popular Green / Industrial look.	- Flexible, durable materials - Universal connections	- Costs and limits of adapting components to new buildings and uses. Might result in costs higher than starting from scratch.	- Splits projects into smaller, shorter interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.	- Replacement after 10 years is an option (allowing renovation and re-branding) but is not forced by technical end-of-life.	- Assembly	- Unpredictable practices
	Disposable	- Short Term - Cheap reprocessing - Low construction costs	- Fixed components. - Economic / biodegradable materials - Cheap recycling / reshaping - Universal connections - Mass production, fast (dis)assembly	- Low investment with quick return and constant material reuse	- Design for fast disassembly and reprocessing would allow for constant material reuse	- Frequent full functional renovations due to short, closed financial cycles.	- Short service and design cycles would allow for constant trend-based redesign.	- Low-cost manufacturing and assembly.	- Technical difficulties of building a system to last for 10 years. 30% of the service life should be delivered by 30% of the cost.	- Producer can take advantage of technological innovations for every cycle of production, use and disposal. Theoretically optimizing material and industrial processes.	- Reduced cost and quick fabrication / installation for clients without long-term vision possibilities.	- Fabrication	- Temporary applications
30 Year	High End	- Long Term - Low operation costs - High construction costs	- Fixed, highly specific components. - Durable materials and connections - Customizable shapes and complex joints - Limited production, labor-intensive (dis)assembly	- Safer, predictable performance and return. - Long term business-to-client relation	- Lower production energy by fully exploiting original service life of materials	- Uninterrupted service-life, few renovations and less invasive maintenance increase user comfort.	- High-end, luxurious appearance with endless potential for customization due to case-by-case design and production.	- Fabrication quality control - Accuracy of financial model (price against costs)	- Time frame and communication with other project parties. Risks have been minimized by years of practice.	- Largest one-time return due to highest initial investment. Performance of facade and financial estimation more likely to be accurate as operation costs are reduced.	- Financial and technical stability, limited interventions for uninterrupted service. High quality for demanding aesthetic standards. - High customization possibilities.	- Financing	- Commercial / solid institutions
	Economic	- Medium Term - High operation costs - Low construction costs	- Fixed, replaceable components. - Component-specific durability - Customizable shapes and complex connections - Combined production, accessible (dis)assembly	- Lower initial investment (lower capitalization and more diversified interests)	- More frequent replacement of vulnerable components with advancing technologies	- Frequent maintenance interventions give a chance for (limited) functional adjustments and upgrades along the way.	- Lower initial investment frees resources for future upgrades. Limited by the long-term nature of the base system.	- Frequent maintenance	- Liability in useful life of components, the client must understand the reasons for a lower initial investment and be aware of the higher maintenance costs.	- More frequent (though smaller) returns over time due to the need for frequent renovation and replacement.	- Smaller initial investment. - Potential for small adjustments at maintenance thresholds.	- Maintaining	- Limited-resource organizations
3(10) Year	Standardized	- Long Term - Cheap exchange - Expensive planning and logistics	- Modular catalogue components. - Long material and connection durability - Limited customization with rigid grid definition - Industrial / Mass fabrication - Plug-and-play (dis)assembly	- Potential for cheaper fabrication processes due to economy of scale. - Shorter reinvestment cycles throughout portfolio	- Optimized production techniques due to large-scale planning and standard fabrication - Faster market integration of emerging technologies.	- Catalogue selection of interchangeable components with plug-and-play connections allow cheap, frequent and radical functional changes.	- Catalogue components allow radical redefinition of the overall facade appearance. Functional layers can act as a showcases for client or third parties.	- Fabrication techniques and universal interconnectivity. - Marketing appeal and component circulation.	- Financing strategies. Service provider becomes a financial entity with long-term ownership. - Storage of unused panels and logistics of replacement.	- Marketing appeal of a flexible system could result in higher service fees. The frequency in which this flexibility is actually used could result in a positive profit difference.	- Optimized flexibility with minimum risk and without further investment. - Functional and strategic freedom for long-term owners with short-term planning possibilities.	- Planning - Marketing - Fabricating	- Long-term owners with frequently changing needs
	Stratified	- Combined Term - Expensive exchange - Cheap planning and logistics	- Combined components. - Component-specific material and connection durability - Intermediate customization with rigid grid definition - Combined fabrication - Intermediate (dis)assembly	- Potential for cheaper fabrication processes due to economy of scale in certain components. - Potential for new mid-term investments at appropriate	- Optimized material use according to layer service-life, reducing reprocessing energy. - Shorter technical cycles allows for more frequent improvement.	- Separation between long term substrate and short term add-ons reduce the dominance of the grid and allow for greater flexibility.	- Appearance can be adjusted more freely and external aesthetic layers are replaced more frequently. Long term structural layers are less dominant.	- Material- and fabrication-process selection to guarantee expected service-lives.	- Service life expectancy of different components. Materials and production processes must be carefully selected to deliver the intended performance and lifespan.	- Reduced "inventory" costs, panels don't have to be managed and stored between clients, only materials are reprocessed. Reduced risk of unused inventory.	- Wider flexibility in the definition of a grid. Form is not tied to universal components, presence of infrastructure or support layers is minimized. Functional and strategic flexibility is still possible.	- Planning - Producing - Installing	- Long-term owners with infrequently changing needs

Notes

* Short - Short service life with low intervention
Medium - Long service life with high intervention
Long - Long service life with low intervention
Combined - Component-specific service life


Project Term
Production Strategy
Financial Strategy
Sustainable Strength
Functional Strength
Strategic Strength
System Keystone(s)
Risks for Provider
Benefits for Provider
Benefits for Client
Main difference against current model
Best for
10 Year
ReUsable
- Long term
- Cheap adjustment
- Medium construction costs
- Correct material selection would lead to flexible durable system that could serve many buildings over its service-life
- Fast installation and low initial investment. Material reutilization would allow more
- Costs and limits of adapting components to new buildings and uses. Might result in costs higher than starting from scratch.
- Splits projects into smaller, shorter interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.
- Replacement after 10 years is an option (allowing renovation and re-branding) but is not forced by technical end-of-life.
- Assembly
- Unpredictable practices
Disposable
- Short Term
- Cheap reprocessing
- Low construction costs
- Fixed components.
- Economic / biodegradable materials
- Cheap recycling / reshaping
- Universal connections
- Mass production, fast (dis)assembly
- Low investment with quick return and constant material reuse
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- Technical difficulties of building a system to last for 10 years. 30% of the service life should be delivered by 30% of the cost.
- Producer can take advantage of technological innovations for every cycle of production, use and disposal. Theoretically optimizing material and industrial processes.
- Reduced cost and quick fabrication / installation for clients without long-term vision possibilities.
- Fabrication
- Temporary applications
30 Year
High End
- Long Term
- Low operation costs
- High construction costs
- Fixed, highly specific components.
- Durable materials and connections
- Customizable shapes and complex joints
- Limited production, labor-intensive (dis)assembly
- Safer, predictable performance and return.
- Long term business-to-client relation
- Lower production energy by fully exploiting original service life of materials
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- Financing
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- More frequent (though smaller) returns over time due to the need for frequent renovation and replacement.
- Smaller initial investment.
- Potential for small adjustments at maintenance thresholds.
- Maintaining
- Limited-resource organizations
3(10) Year
Standardized
- Long Term
- Cheap exchange
- Expensive planning and logistics
- Modular catalogue components.
- Long material and connection durability
- Limited customization with rigid grid definition
- Industrial / Mass fabrication
- Plug-and-play (dis)assembly
- Potential for cheaper fabrication processes due to economy of scale.
- Shorter reinvestment cycles throughout portfolio
- Optimized production techniques due to large-scale planning and standard fabrication
- Faster market integration of emerging technologies.
- Financing strategies. Service provider becomes a financial entity with long-term ownership.
- Storage of unused panels and logistics of replacement.
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- Optimized flexibility with minimum risk and without further investment.
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- Planning
- Marketing
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- Long-term owners with frequently changing needs
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- Planning
- Producing
- Installing
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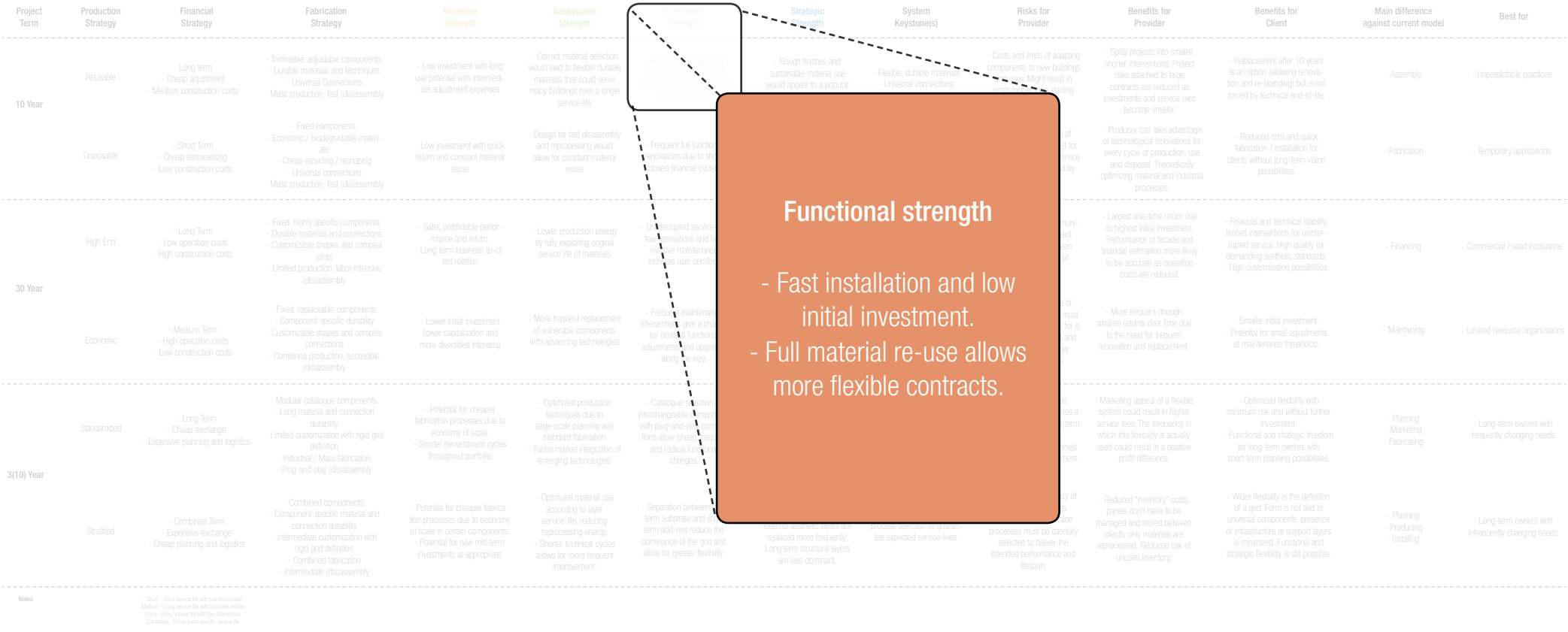
Notes
Fabrication Strategy
- Trimmable, adjustable components.
- Durable materials and techniques.
Universal connections.
- Mass production, fast (dis)assembly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- Limited-resource organizations
3(10) Year
Standardized
- Long Term
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- Planning
- Marketing
- Fabricating
- Long-term owners with frequently changing needs
Stratified
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- Planning
- Producing
- Installing
- Long-term owners with infrequently changing needs
Notes
Functional strength
- Fast installation and low initial investment.
- Full material re-use allows more flexible contracts.

Project Term	Production Strategy	Financial Strategy	Fabrication Strategy	Financial Strength	Sustainable Strength	Functional Strength	Strategic Strength	System Keystone(s)	Risks for Provider	Benefits for Provider	Benefits for Client	Main difference against current model	Best for
10 Year	ReUsable	- Long term - Cheap adjustment - Medium construction costs	- Trimmable, adjustable components. - Durable materials and techniques - Universal Connections - Mass production, fast (dis)assembly	- Low investment with long use potential with intermedi- ate adjustment expenses	- Correct material selection would lead to flexible durable materials that could serve many buildings over a single	- Fast installation and low initial investment. Material reutilization would allow more	- Rough finishes and sustainable material use would appeal to a popular Green / Industrial look.	- Flexible, durable materials - Universal connections	- Costs and limits of adapting components to new buildings and uses. Might result in costs higher than starting from scratch.	- Splits projects into smaller, shorter interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.	- Replacement after 10 years is an option (allowing renova- tion and re-branding) but is not forced by technical end-of-life.	- Assembly	- Unpredictable practices
	Disposable	- Short Term - Cheap reprocessing - Low construction costs	- Fixed components. - Economic / biodegradable materi- als - Cheap recycling / reshaping - Universal connections - Mass production, fast (dis)assembly				- Short service and design cycles would allow for constant trend-based redesign.	- Low-cost manufacturing and assembly.	- Technical difficulties of building a system to last for 10 years. 30% of the service life should be delivered by 30% of the cost.	- Producer can take advantage of technological innovations for every cycle of production, use and disposal. Theoretically optimizing material and industrial processes.	- Reduced cost and quick fabrication / installation for clients without long-term vision possibilities.	- Fabrication	- Temporary applications
30 Year	High End	- Long Term - Low operation costs - High construction costs	- Fixed, highly specific components. - Durable materials and connections - Customizable shapes and complex joints - Limited production, labor-intensive (dis)assembly				- High-end, luxurious appearance with endless potential for customization due to case-by-case design and production.	- Fabrication quality control - Accuracy of financial model (price against costs)	- Time frame and communi- cation with other project parties. Risks have been minimized by years of practice.	- Largest one-time return due to highest initial investment. Performance of facade and financial estimation more likely to be accurate as operation costs are reduced.	- Financial and technical stability, limited interventions for uninter- rupted service. High quality for demanding aesthetic standards. - High customization possibilities.	- Financing	- Commercial / solid institutions
	Economic	- Medium Term - High operation costs - Low construction costs	- Fixed, replaceable components. - Component-specific durability - Customizable shapes and complex connections - Combined production, accessible (dis)assembly				- Lower initial investment frees resources for future upgrades. Limited by the long-term nature of the base system.	- Frequent maintenance	- Liability in useful life of components, the client must understand the reasons for a lower initial investment and be aware of the higher maintenance costs.	- More frequent (though smaller) returns over time due to the need for frequent renovation and replacement.	- Smaller initial investment. - Potential for small adjustments at maintenance thresholds.	- Maintaining	- Limited-resource organizations
3(10) Year	Standardized	- Long Term - Cheap exchange - Expensive planning and logistics	- Modular catalogue components. - Long material and connection durability - Limited customization with rigid grid definition - Industrial / Mass fabrication - Plug-and-play (dis)assembly				- Catalogue components allow radical redefinition of the overall facade appear- ance. Functional layers can act as a showcases for client or third parties.	- Fabrication techniques and universal interconnectivity. - Marketing appeal and component circulation.	- Financing strategies. Service provider becomes a financial entity with long-term ownership. - Storage of unused panels and logistics of replacement.	- Marketing appeal of a flexible system could result in higher service fees. The frequency in which this flexibility is actually used could result in a positive profit difference.	- Optimized flexibility with minimum risk and without further investment. - Functional and strategic freedom for long-term owners with short-term planning possibilities.	- Planning - Marketing - Fabricating	- Long-term owners with frequently changing needs
	Stratified	- Combined Term - Expensive exchange - Cheap planning and logistics	- Combined components. - Component-specific material and connection durability - Intermediate customization with rigid grid definition - Combined fabrication - Intermediate (dis)assembly				- Appearance can be adjusted easily and external aesthetic layers are replaced more frequently. Long term structural layers are less dominant.	- Material- and fabrication- process selection to guaran- tee expected service-lives.	- Service life expectancy of different components. Materials and production processes must be carefully selected to deliver the intended performance and lifespan.	- Reduced "inventory" costs, panels don't have to be managed and stored between clients, only materials are reprocessed. Reduced risk of unused inventory.	- Wider flexibility in the definition of a grid. Form is not tied to universal components, presence of infrastructure or support layers is minimized. Functional and strategic flexibility is still possible.	- Planning - Producing - Installing	- Long-term owners with infrequently changing needs

Notes

- Short - Short service life with low intervention
- Medium - Long service life with high intervention
- Long - Long service life with low intervention
- Combined - Component-specific service life

System Keystone

- Fabrication techniques and universal interconnectivity.
- Marketing appeal and component circulation.

Façade Leasing | **Renovation strategies -** Planning and comparison

Risks for provider
- Technical difficulty of building a system to last 10 years. 30% of service life should be delivered at 30% of the cost.

Benefits for provider
- Production can take advantage of technological innovation in shorter cycles. In theory optimizing material and industrial processes

Project Term	Production Strategy	Financial Strategy	Fabrication Strategy	Financial Strength	Sustainable Strength	Functional Strength	Strategic Strength	System Keystone(s)	Risks for Provider	Benefits for Provider	Benefits for Client	Main difference against current model	Best for
10 Year	ReUsable	- Long term - Cheap adjustment - Medium construction costs	- Trimmable, adjustable components. - Durable materials and techniques - Universal Connections - Mass production, fast (dis)assembly	- Low investment with long use potential with intermediate adjustment expenses				- Flexible, durable materials - Universal connections	- Costs and limits of adapting components to new buildings and uses. Might result in costs higher than starting from scratch.	- Splits projects into smaller, shorter interventions. Project risks attached to large contracts are reduced as investments and service lives become smaller.	- Replacement after 10 years is an option (allowing renovation and re-branding) but is not forced by technical end-of-life.	- Assembly	- Unpredictable practices
	Disposable	- Short Term - Cheap reprocessing - Low construction costs	- Fixed components. - Economic / biodegradable materials - Cheap recycling / reshaping - Universal connections - Mass production, fast (dis)assembly	- Low investment with quick return and constant material reuse				- Low-cost manufacturing and assembly.	- Technical difficulties of building a system to last for 10 years. 30% of the service life should be delivered by 30% of the cost.	- Producer can take advantage of technological innovations for every cycle of production, use and disposal. Theoretically optimizing material and industrial processes.	- Reduced cost and quick fabrication / installation for clients without long-term vision possibilities.	- Fabrication	- Temporary applications
30 Year	High End	- Long Term - Low operation costs - High construction costs	- Fixed, highly specific components. - Durable materials and connections - Customizable shapes and complex joints - Limited production, labor-intensive (dis)assembly	- Safer, predictable performance and return. - Long term business-to-client relation				- Fabrication quality control - Accuracy of financial model (price against costs)	- Time frame and communication with other project parties. Risks have been minimized by years of practice.	- Largest one-time return due to highest initial investment. Performance of facade and financial estimation more likely to be accurate as operation costs are reduced.	- Financial and technical stability, limited interventions for uninterrupted service. High quality for demanding aesthetic standards. - High customization possibilities.	- Financing	- Commercial / solid institutions
	Economic	- Medium Term - High operation costs - Low construction costs	- Fixed, replaceable components. - Component-specific durability - Customizable shapes and complex connections - Combined production, accessible (dis)assembly	- Lower initial investment (lower capitalization and more diversified interests)				- Frequent maintenance	- Liability in useful life of components, the client must understand the reasons for a lower initial investment and be aware of the higher maintenance costs.	- More frequent (though smaller) returns over time due to the need for frequent renovation and replacement.	- Smaller initial investment. - Potential for small adjustments at maintenance thresholds.	- Maintaining	- Limited-resource organizations
3(10) Year	Standardized	- Long Term - Cheap exchange - Expensive planning and logistics	- Modular catalogue components. - Long material and connection durability - Limited customization with rigid grid definition - Industrial / Mass fabrication - Plug-and-play (dis)assembly					Fabrication techniques and universal interconnectivity. - Marketing appeal and component circulation.	- Financing strategies. Service provider becomes a financial entity with long-term ownership. - Storage of unused panels and logistics of replacement.	- Marketing appeal of a flexible system could result in higher service fees. The frequency in which this flexibility is actually used could result in a positive profit difference.	- Optimized flexibility with minimum risk and without further investment. - Functional and strategic freedom for long-term owners with short-term planning possibilities.	- Planning - Marketing - Fabricating	- Long-term owners with frequently changing needs
	Stratified	- Combined Term - Expensive exchange - Cheap planning and logistics	- Combined components. - Component-specific material and connection durability - Intermediate customization with rigid grid definition - Combined fabrication - Intermediate (dis)assembly	- Potential for cheaper fabrication processes due to economy of scale in certain components. - Potential for new mid-term investments at appropriate	- Optimized material use according to layer service-life, reducing reprocessing energy. - Shorter technical cycles allows for more frequent improvement.	- Separation between long term substrate and short term add-ons reduce the dominance of the grid and allow for greater flexibility.	- Appearance can be adjusted more freely and external aesthetic layers are replaced more frequently. Long term structural layers are less dominant.	- Material- and fabrication-process selection to guarantee expected service-lives.	- Service life expectancy of different components. Materials and production processes must be carefully selected to deliver the intended performance and lifespan.	- Reduced "inventory" costs, panels don't have to be managed and stored between clients, only materials are reprocessed. Reduced risk of unused inventory.	- Wider flexibility in the definition of a grid. Form is not tied to universal components, presence of infrastructure or support layers is minimized. Functional and strategic flexibility is still possible.	- Planning - Producing - Installing	- Long-term owners with infrequently changing needs

Notes

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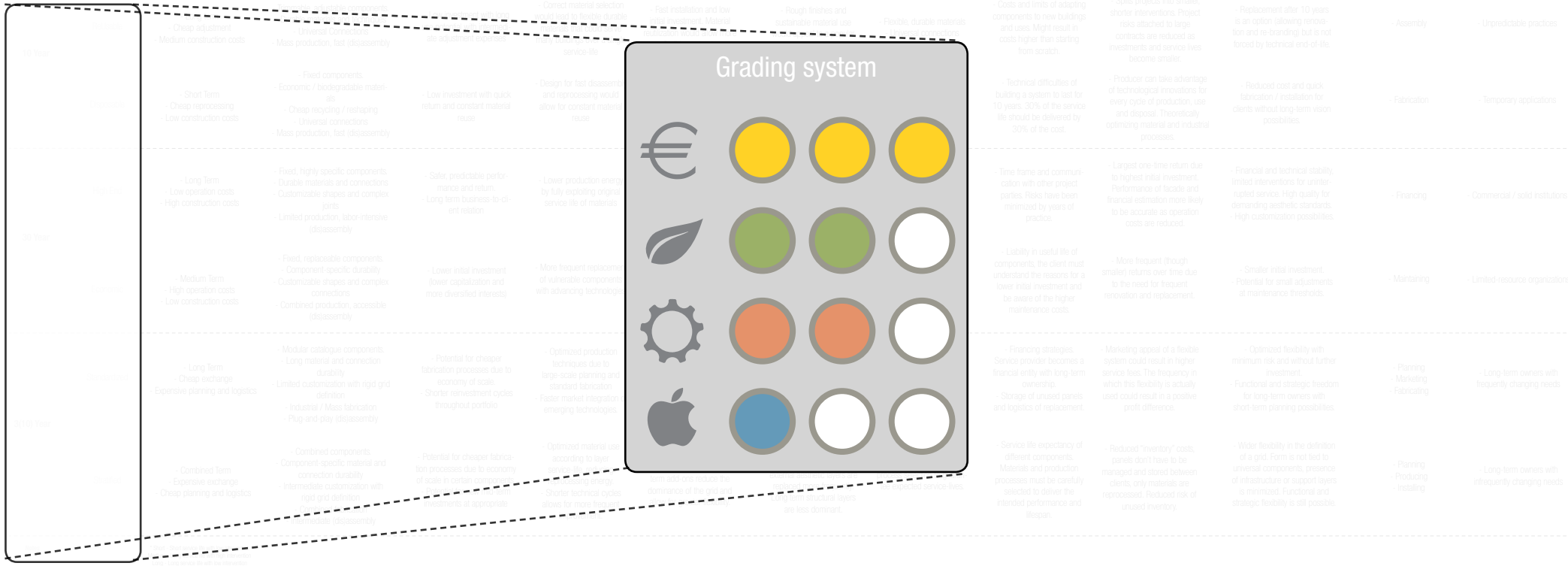
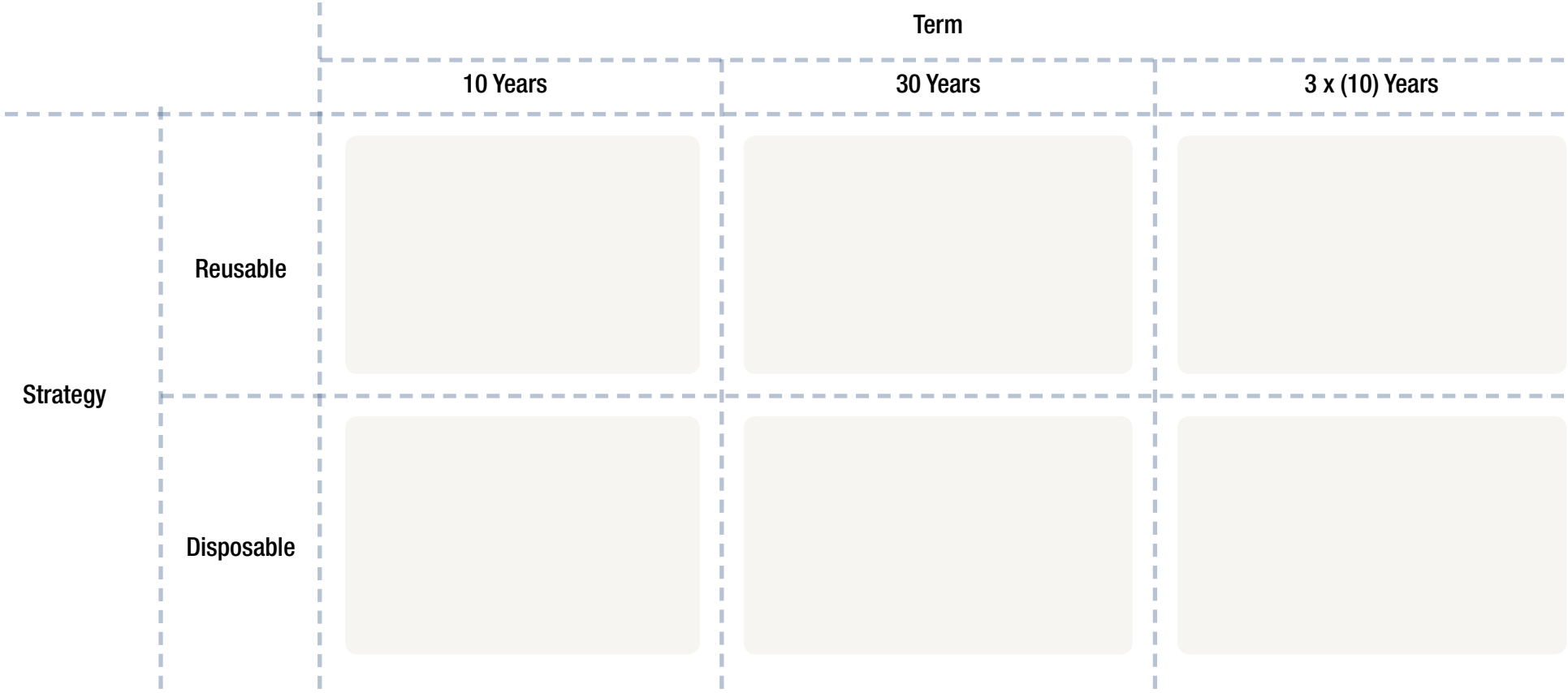
Medium - Long service life with high intervention
Long - Long service life with low intervention
Combined - Component-specific service life


Grading system


Term
10 Years
30 Years
3 x (10) Years
Strategy
Reusable
Disposable

Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES		
Disposable			

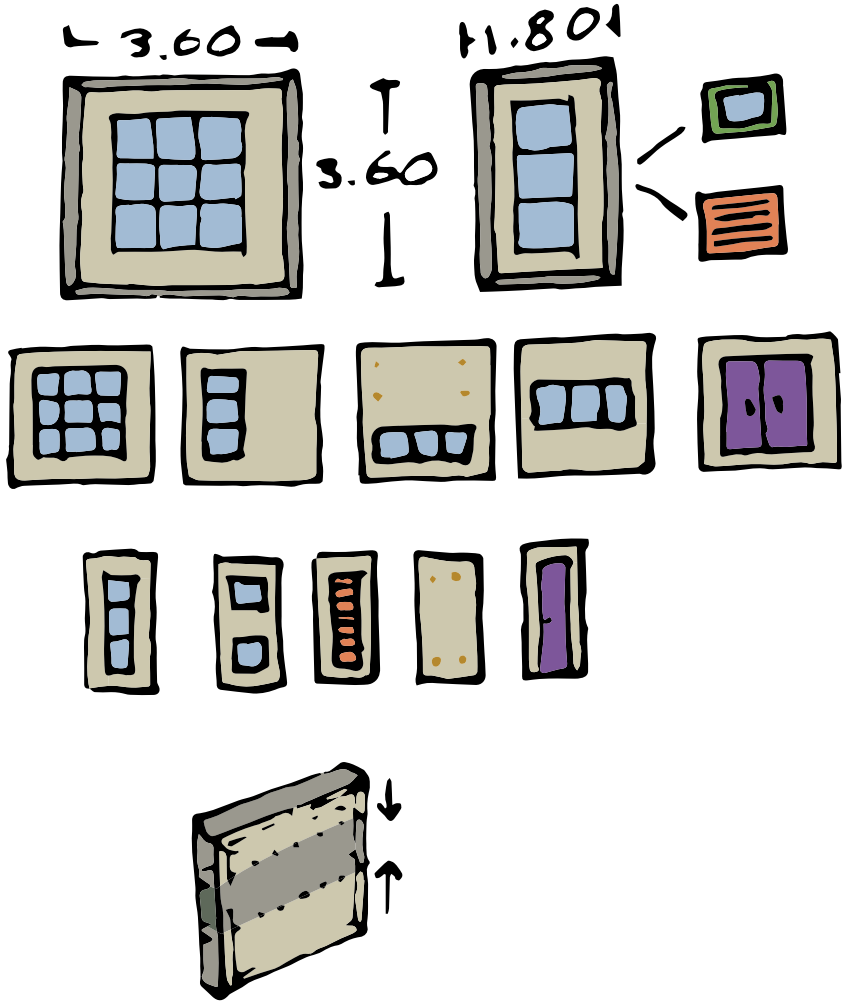
Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES		
Disposable	IKEA® FACADES		

Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES	ROLLS ROYCE FACADE GROUP	
Disposable	IKEA FACADES		

Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES	ROLLS ROYCE FACADE GROUP	
Disposable	IKEA® FACADES	XBOX™ FACADES	

Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES	ROLLS ROYCE FACADE GROUP	PANDORA UNFORGETTABLE FACADES
Disposable	IKEA® FACADES	XBOX™ FACADES	

Strategy	Term: 10 Years	Term: 30 Years	Term: 3 x (10) Years
Reusable	DE MEEUW FACADES	ROLLS ROYCE FACADE GROUP	PANDORA UNFORGETTABLE FACADES
Disposable	IKEA® FACADES	XBOX™ FACADES	iFacade

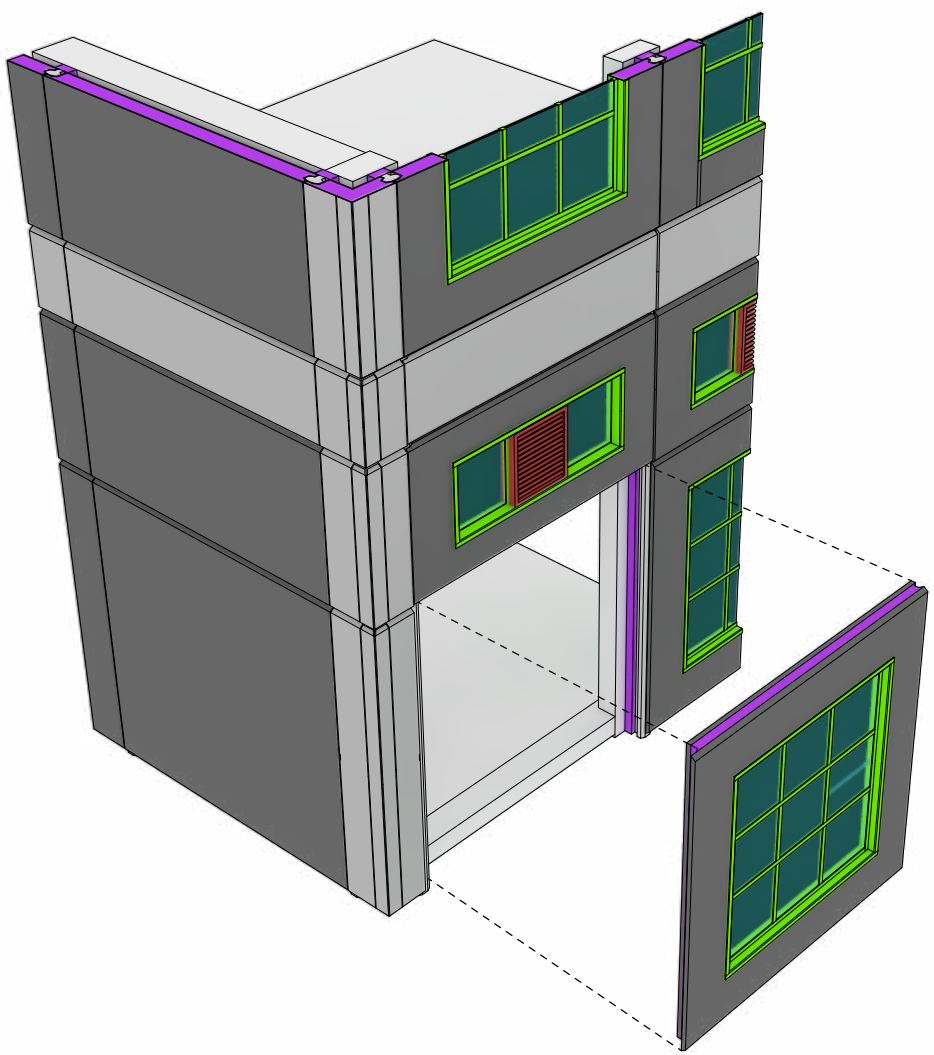


Related branding: Temporary solutions to momentary problems

DE MEEUW FACADES

4-Value Performance:

- Increased return in the long-run / Risk of dead inventory
- No reprocessing resource use
- Fast installation and removal
- Utilitarian look



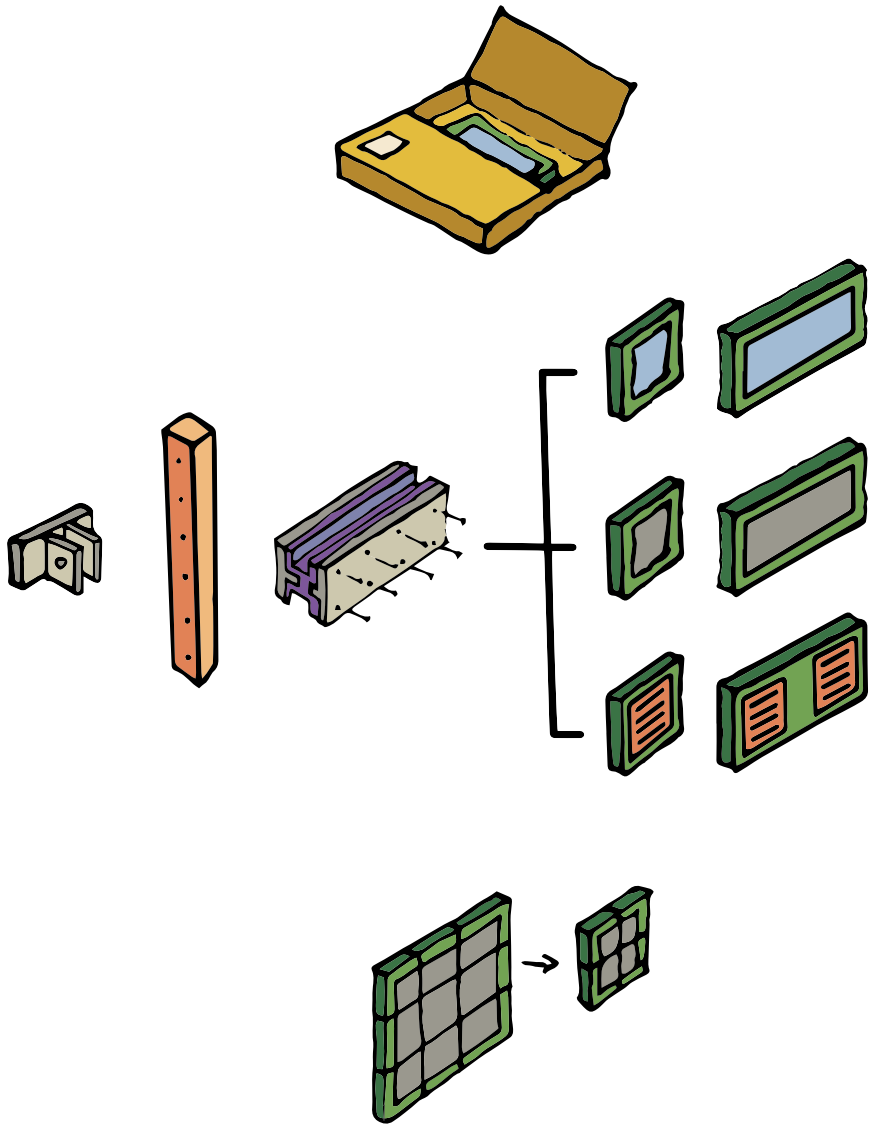
Related branding: Temporary solutions to momentary problems

DE MEEUW FACADES

4-Value Performance:

Design Keystone:

Assembly, durability and transportability.

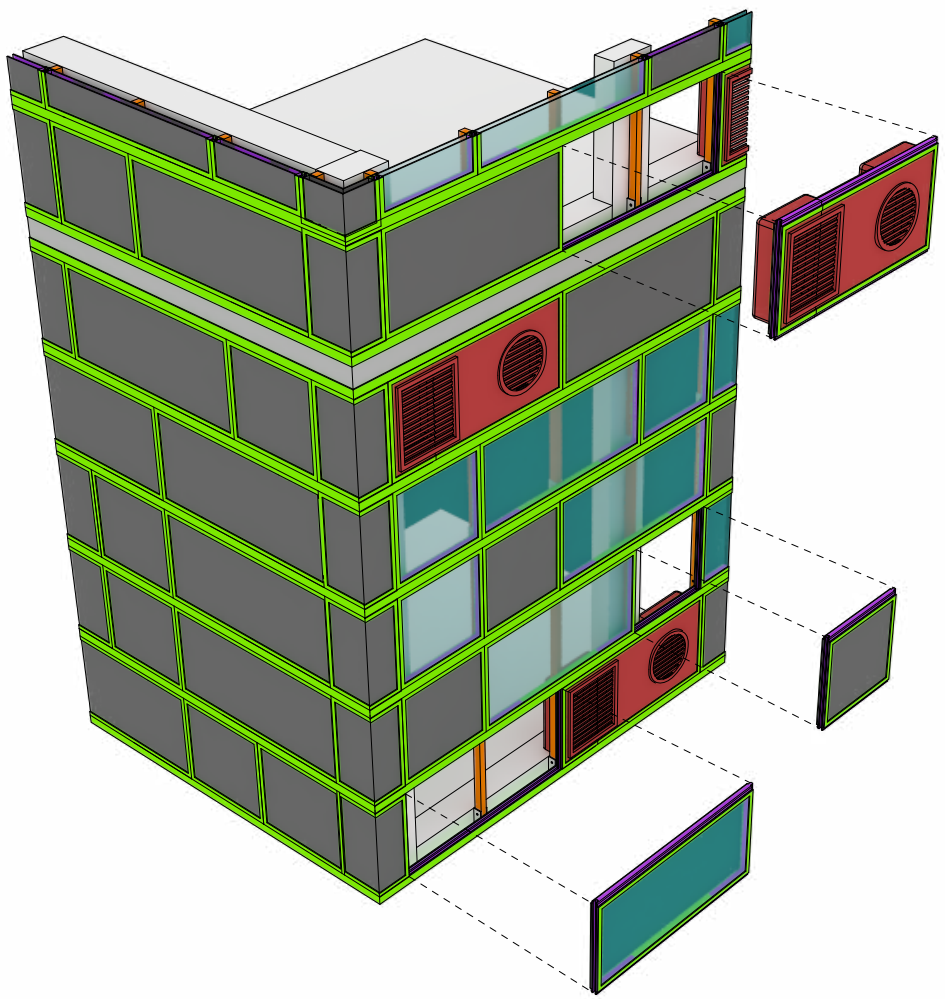


Related branding: Trendy design, cheap to produce, easy to assemble

IKEA®
FACADES

4-Value Performance:

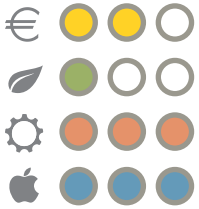
- Small initial cost foments regular replacement
  Long-term cost might end up being higher
- Hard to regulate service-life of all components equally
- Constant functional renovations possible
- Trend-based design possible



Related branding: Trendy design, cheap to produce, easy to assemble

IKEA® FACADES

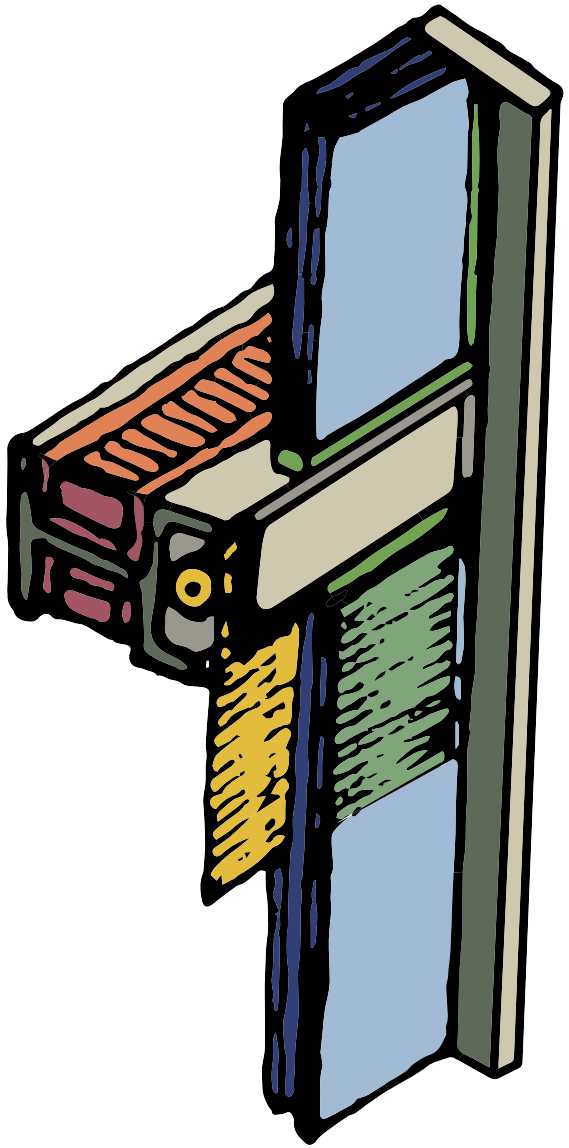
4-Value Performance:



Design Keystone:

Standardization, joining and renewable material use.

Façade Leasing | Value-Engineered design scenarios - 30 year High-End (reusable)



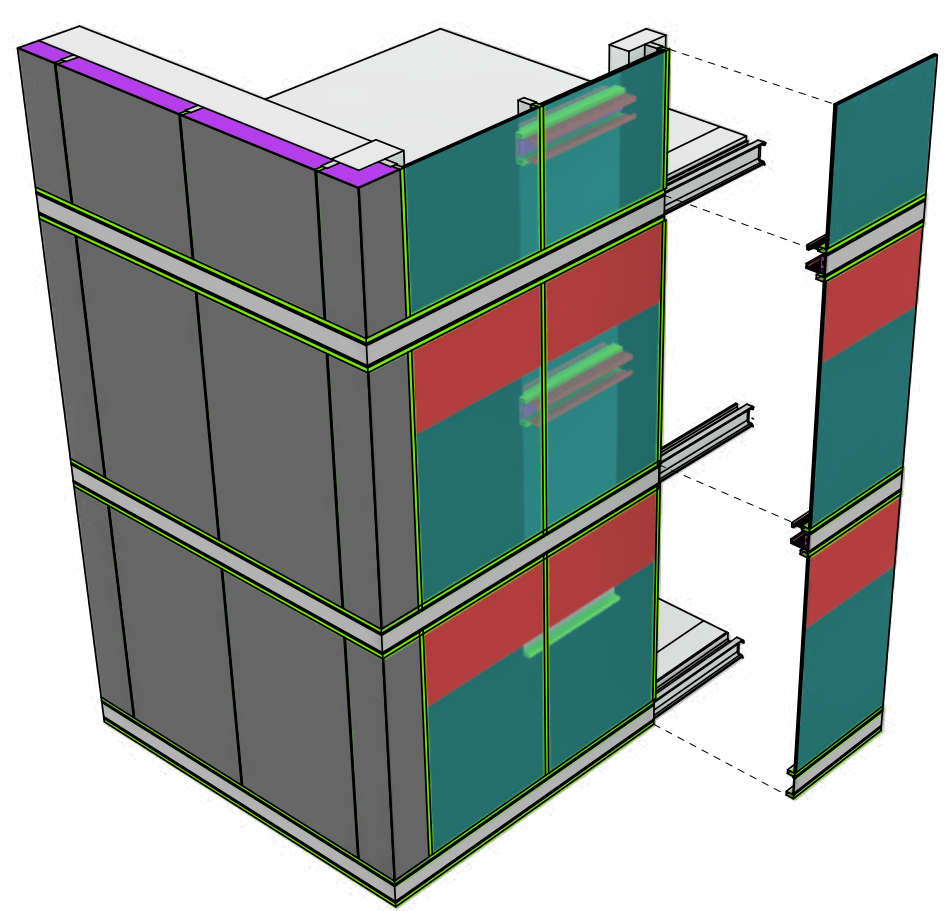
Related branding: Invest once, use forever

ROLLS ROYCE **FACADE** GROUP

4-Value Performance:

- Higher investment is justified by higher predictability
- Without space for updates obsolescence is always a risk
  Materials are used for as long as possible
- One-system-fits-all, limited flexibility over time
- High customization potential and long term recognition

Façade Leasing | Value-Engineered design scenarios - 30 year High-End (reusable)



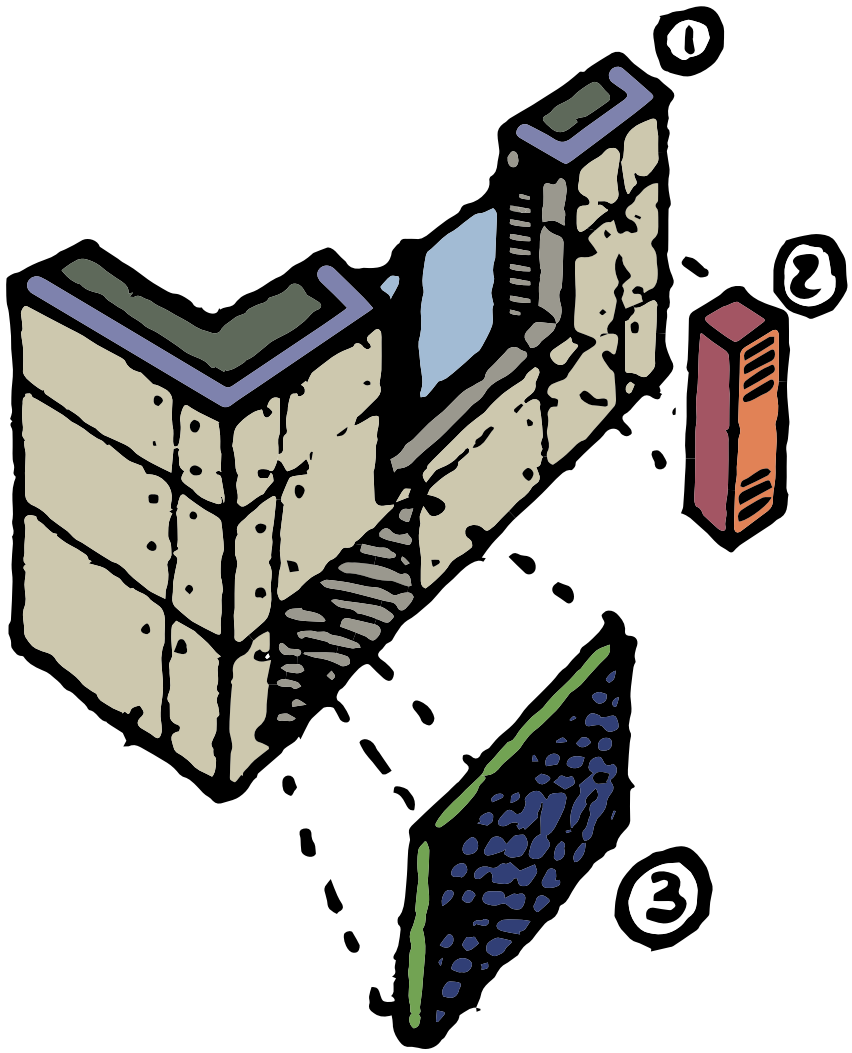
Related branding: Invest once, use forever

ROLLS ROYCE **FACADE** GROUP

4-Value Performance:

Design Keystone:

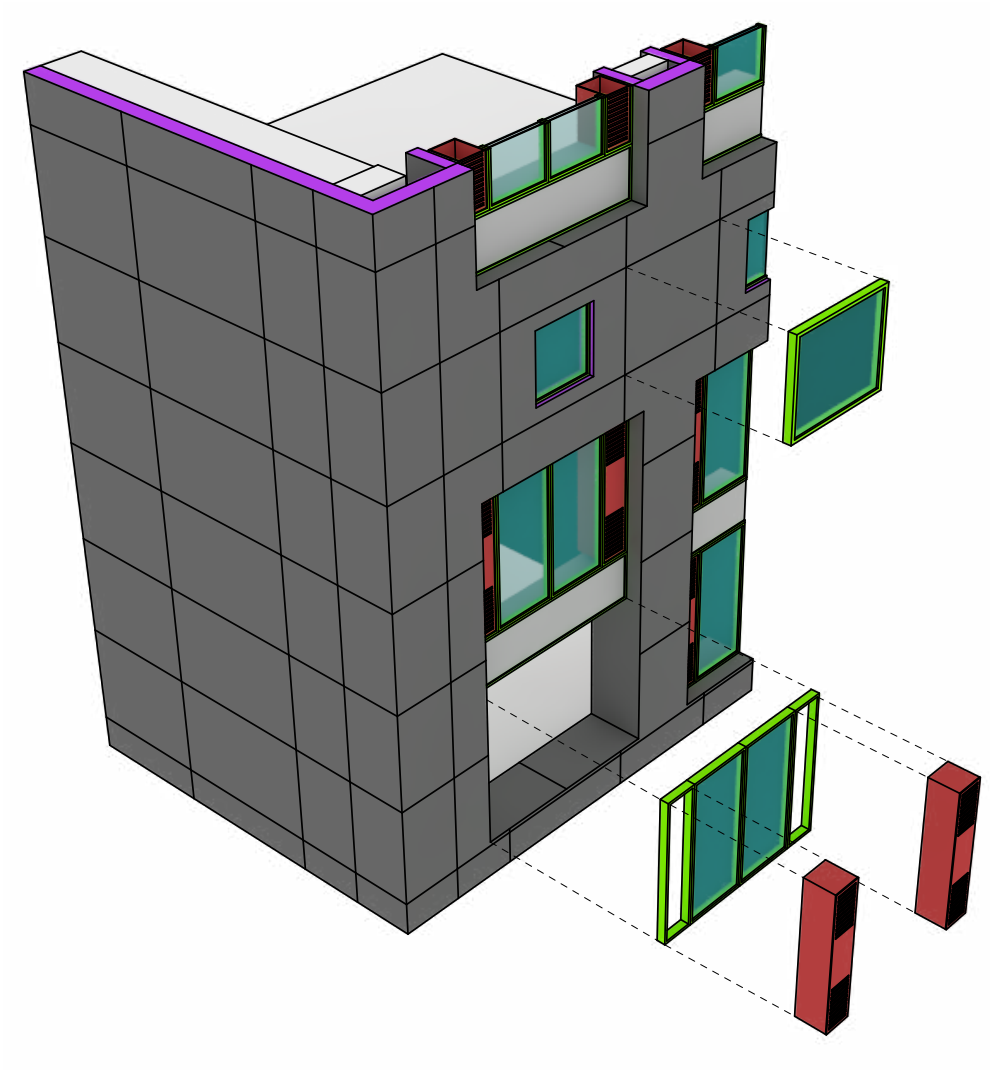
Durability of material and currency of technologies.



Related branding: The more you spend the more fun you get

4-Value Performance:

- Smaller Initial investment
  Service-life of certain components not exploited
- Material use not optimized, energy savings gradual
- Changes done according to necessity and possibility
  Range of intervention increasingly limited
- Visual continuity might be a problem, activities affected



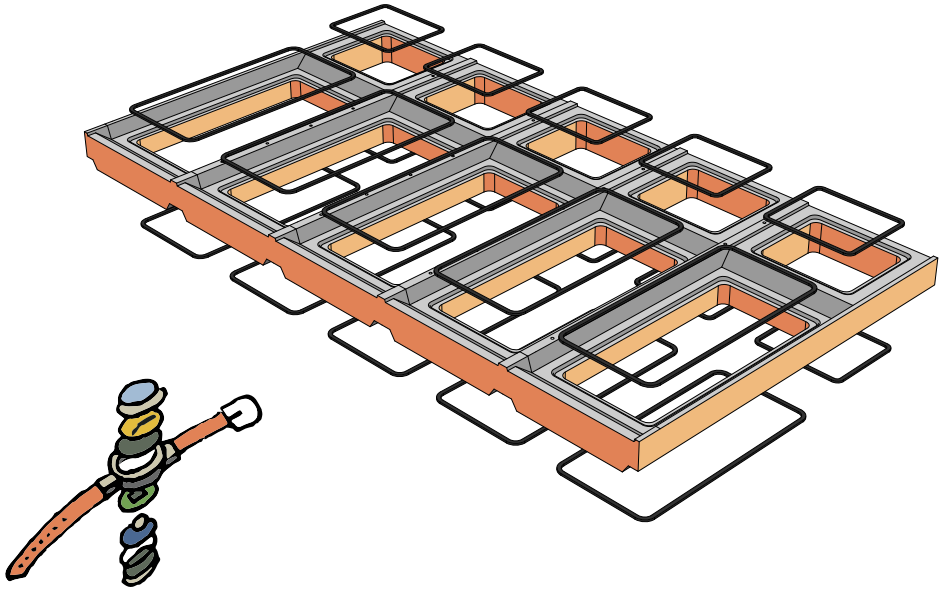
Related branding: The more you spend the more fun you get

4-Value Performance:

Design Keystone:

Continuity between renovations

Façade Leasing | Value-Engineered design scenarios - 3x(10) year Standardized (reusable)



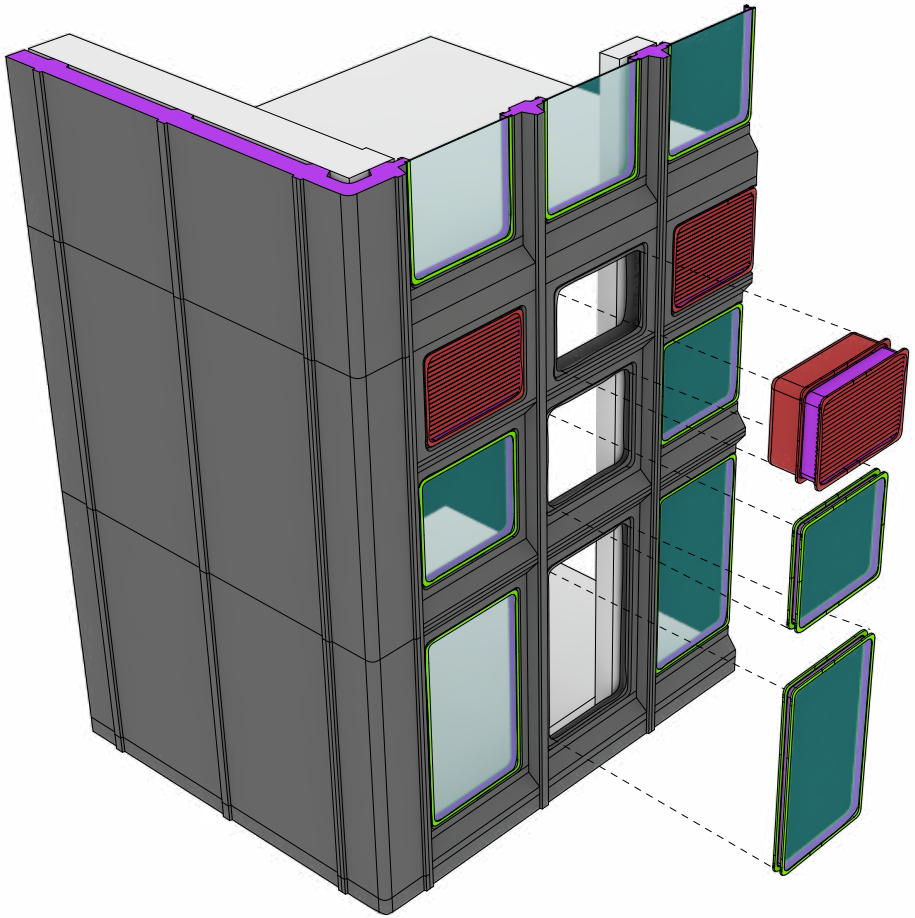
Related branding: Catalogue sales, continuous client engagement

PANDORA
UNFORGETTABLE FACADES

4-Value Performance:

- Components available on demand, cost-effective production
  Risk of slow inventory
- Material life optimized, intermediate energy-use limited
- High degree of flexibility with low cost and free term
- Cosmetic personalization very limited

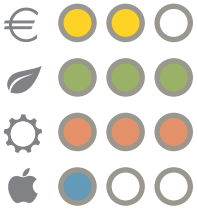
Façade Leasing | Value-Engineered design scenarios - 3x(10) year Standardized (reusable)



Related branding: Catalogue sales, continuous client engagement

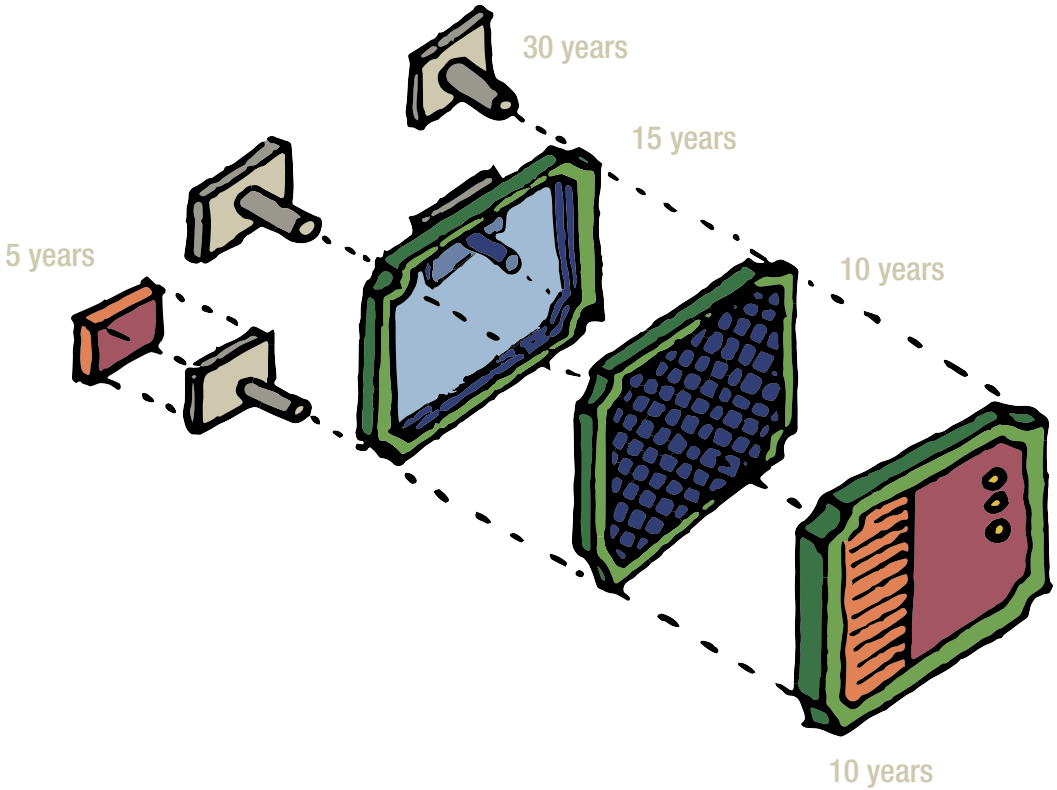
PANDORA
UNFORGETTABLE FACADES

4-Value Performance:



Design Keystone:

Universal inter-connectivity and marketing appeal.



Related branding: Planning for obsolescence

iFacade

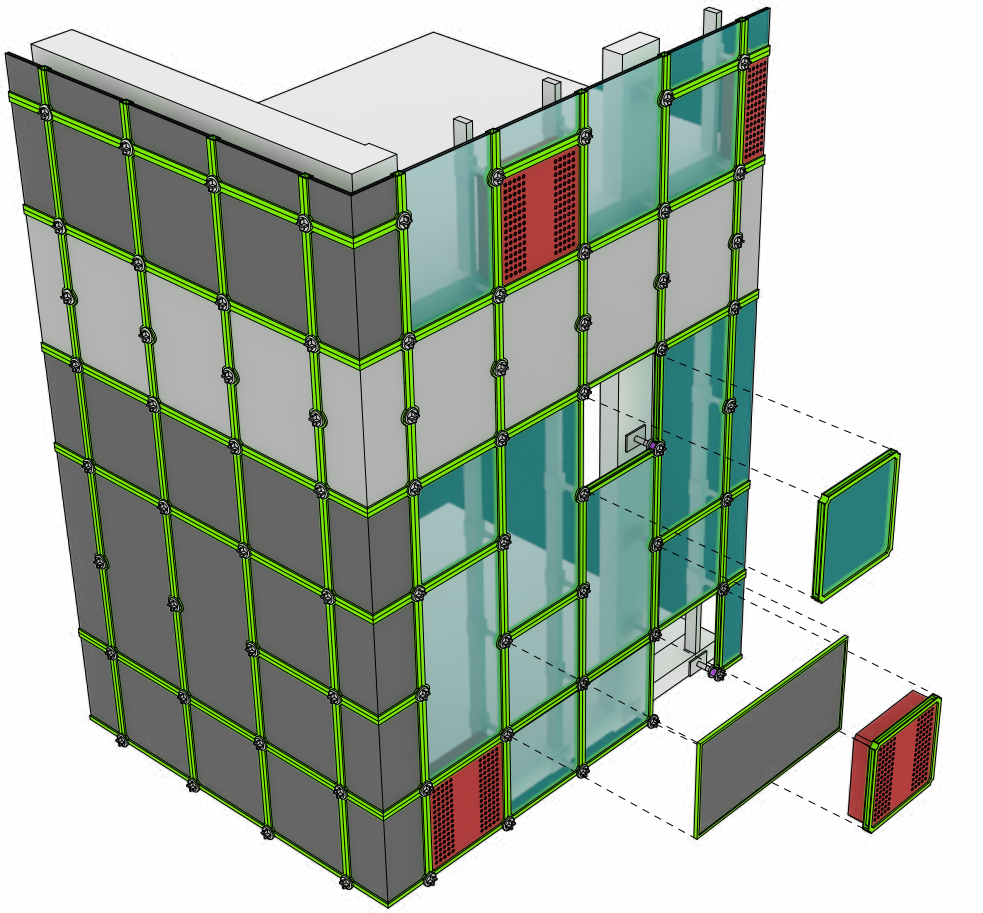
4-Value Performance:

Investment according to necessity
Planned obsolescence results in higher final costs

Technological integration optimized
High reprocessing energy

High flexibility, components always “new”

Constant redesign of top layers guarantee currency



Related branding: Planning for obsolescence

iFacade

4-Value Performance:

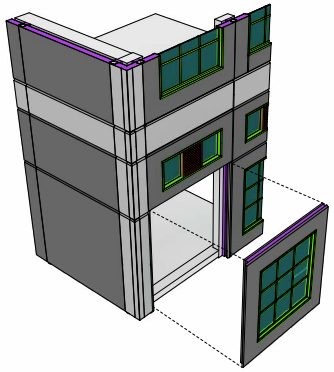
Design Keystone:

Material and production process to satisfy specific service-lives.

Façade Leasing | Strategies according to intended client

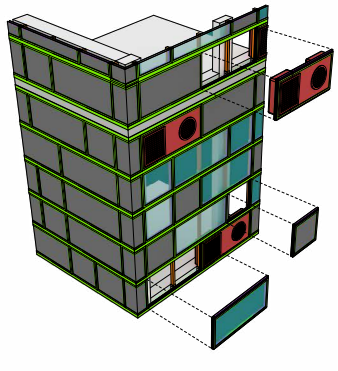
DE MEEUW FACADES

Temporary life-extension or market-integration projects



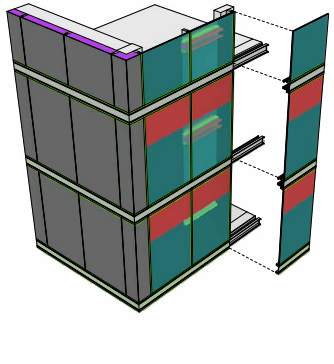
IKEA FACADES

Short-term owners and “Fit-out” tenants



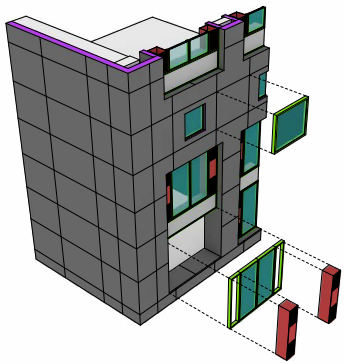
ROLLS ROYCE FACADE GROUP

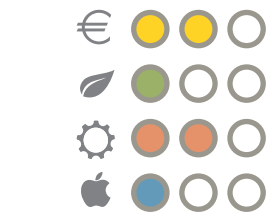
Stable organizations with long-term ownership and planning capacity



XBOX FACADES

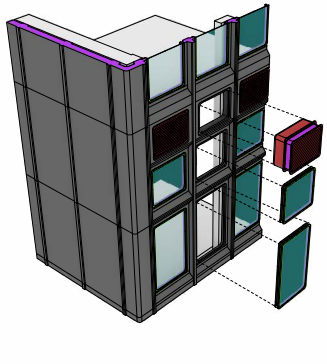
Limited resources or permission, unpredictable occupation

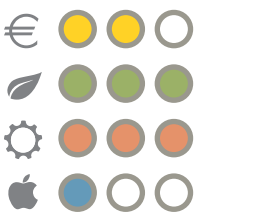




PANDORA UNFORGETTABLE FACADES

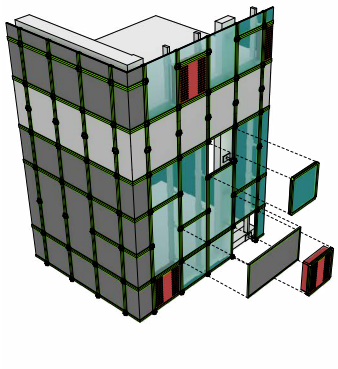
Long-term owners with changing needs (eg. Universities)

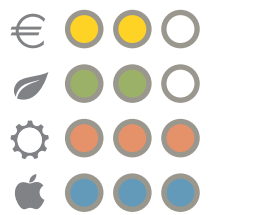


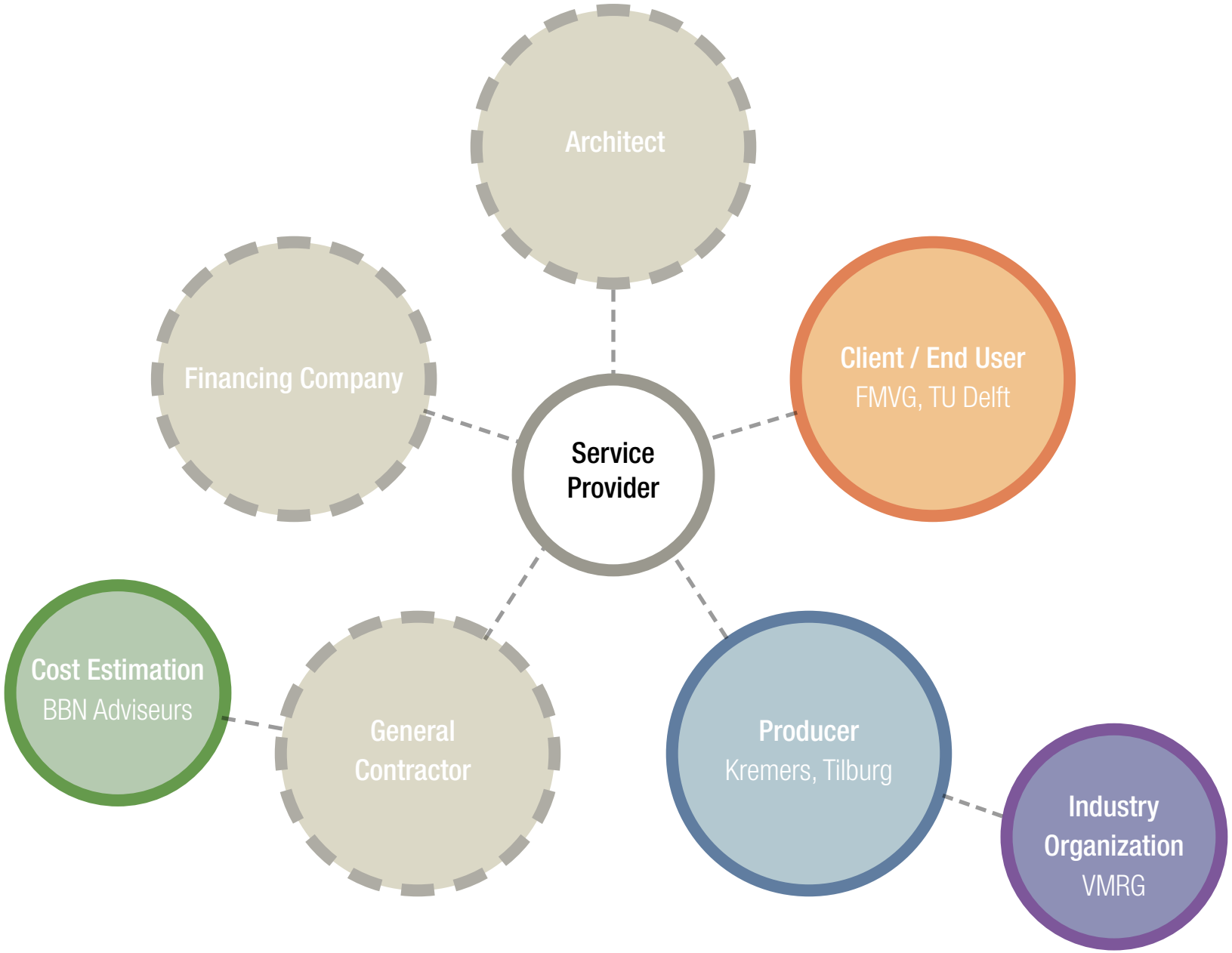


iFacade

Long-term owners with demanding functional and branding needs



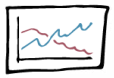



Architect
Financing Company
Client / End User
FMVG, TU Delft
Service Provider
Cost Estimation
BBN Adviseurs
General Contractor
Producer
Kremers, Tilburg
Industry Organization
VMRG


Broader portfolio flexibility
Longer service-life, improved performance, optimize use of space

Façade Leasing | Evaluation - System advantages

More frequent upgrades to the top 20% performance



Long-term investment opportunities, unlike short-term technological leasing

Increased information continuity from project to project

Standard iconicity is cheaper than formal uniqueness

Simplify design, maintain certain degree of design choices

Broader portfolio flexibility

Longer service-life, improved performance, optimize use of space

Façade Leasing | Evaluation - System advantages

More frequent upgrades to the top 20% performance

Long-term investment opportunities, unlike short-term technological leasing

Increased information continuity from project to project

Standard iconicity is cheaper than formal uniqueness

Simplify design, maintain certain degree of design choices

Wider stability/predictability for DBFOM contracts

Continuity of business-to-client relation over the service-life of the facade

Economy of scale due to system standardization

Entirely new business field

Lower risks and liabilities, increase reliability.

Broader portfolio flexibility

Longer service-life, improved performance, optimize use of space

Façade Leasing | Evaluation - System advantages

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Faster new-system integration

Potential for product-based marketing

Anchor service for additional renovation projects

Service recognition and permanent partnership integration

Diversifies financing options to attract different clients

More frequent upgrades to the top 20% performance

Long-term investment opportunities, unlike short-term technological leasing

Increased information continuity from project to project

Standard iconicity is cheaper than formal uniqueness

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Broader portfolio flexibility

Longer service-life, improved performance, optimize use of space

Faster new-system integration

Potential for product-based marketing

Anchor service for additional renovation projects

Service recognition and permanent partnership integration

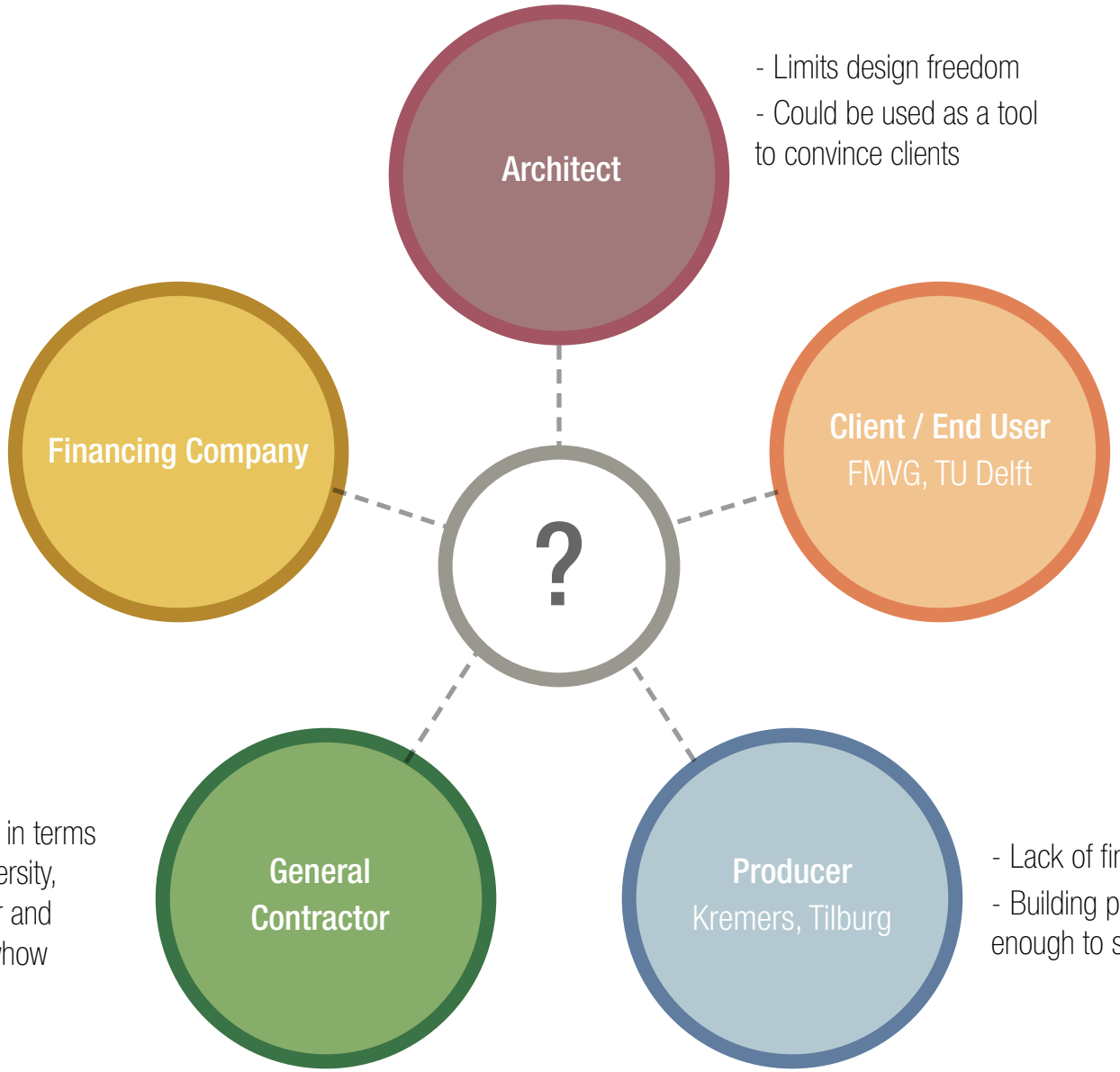
Diversifies financing options to attract different clients

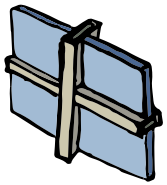
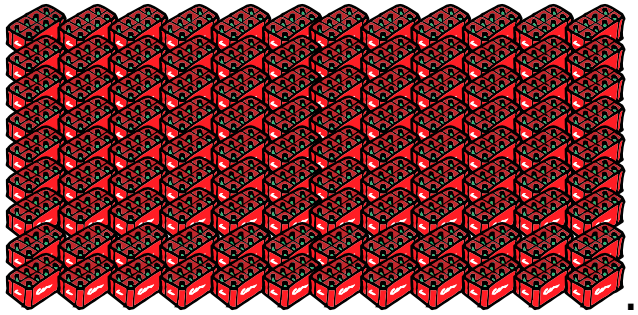
Building's efficiency remains the provider / contractor's responsibility

Material ownership promotes reusing-recycling

Familiarity with system would lead to reduced waste and higher efficiency

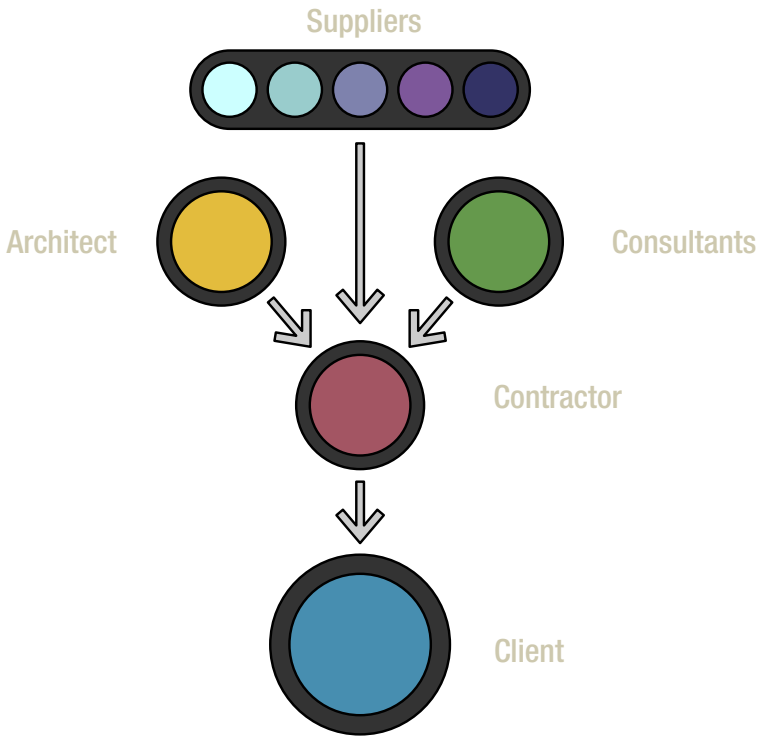
Reliable, long-term investments prove financially sustainable.


Architect
- Limits design freedom
- Could be used as a tool to convince clients
Financing Company
- Lack of technical expertise
- Scale of required capital
?
Client / End User
FMVG, TU Delft
- Extra cost can be offset by improved productivity
- Short-term contract needs
General Contractor
- Best position in terms of portfolio diversity, financial power and technical knowhow
Producer
Kremers, Tilburg
- Lack of financial expertise
- Building portfolio not broad enough to spread risks

Average service-life / consumption rate		Generations in 40 years
Facades		1 service-life
Architects		1.5 retired
IKEA		8 generations
SmartPhones		23rd
CocaCola		29,200 portions

...

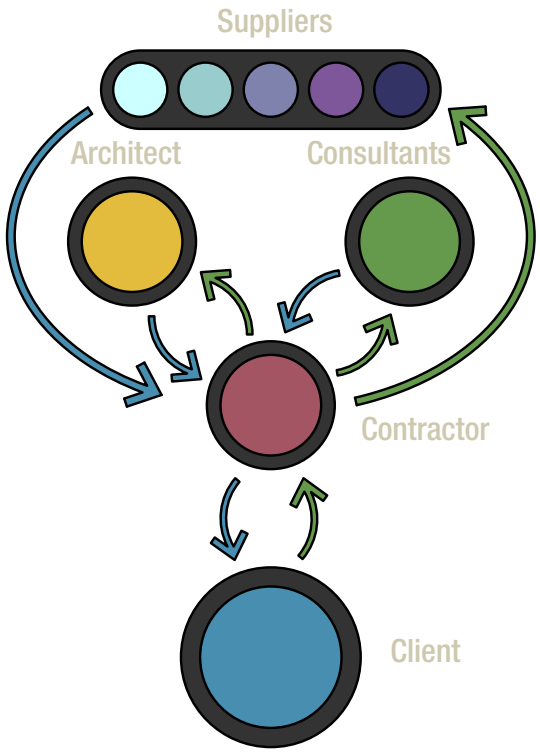
Legal system



Product-based
Warranties and liabilities

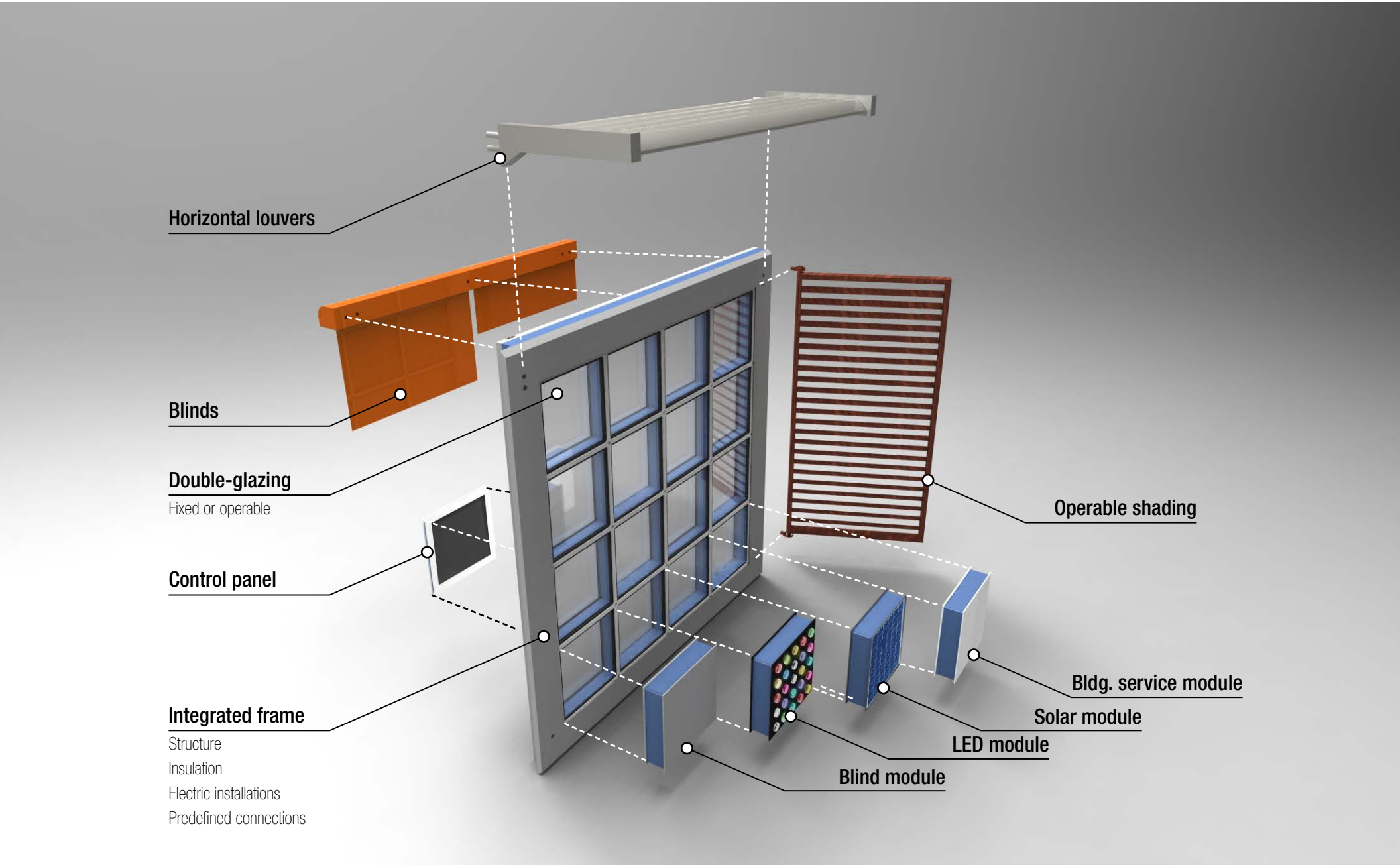
Poor communication and continuity

Technical system



Service delivery-based
Performance

Constant communication.
Continuity of materials and knowledge.


Horizontal louvers
Blinds
Double-glazing
Fixed or operable
Control panel
Integrated frame
Structure
Insulation
Electric installations
Predefined connections
Operable shading
Bldg. service module
Solar module
LED module
Blind module