Empa Materials Science and Technology
UNIVERSITÉ DE GENÈVE
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ENERGY EFFICIENCY IN BUILDINGS

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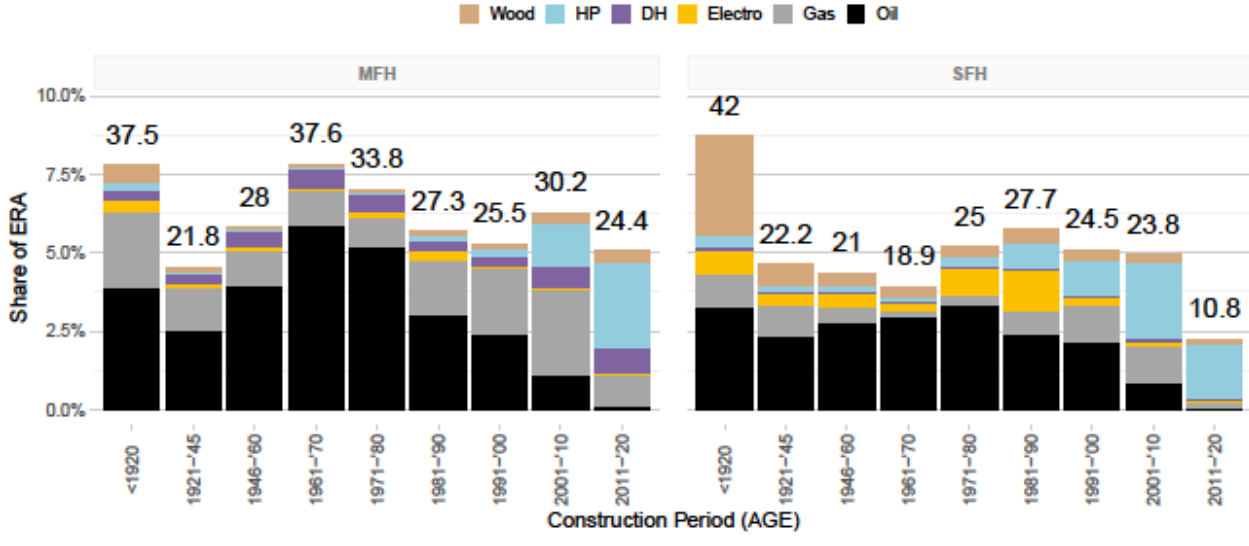
Building Stock

Amount of buildings [1000x]					
	AGE	URBAN	SUBURBAN	RURAL	TOTAL
MFH	≤1920	34	15	23	72
	1921-'45	25	7	8	40
	1946-'60	27	10	6	43
	1961-'70	21	15	9	45
	1971-'80	15	14	10	39
	1981-'90	12	13	10	35
	1991-'00	10	13	10	32
	2001-'10	11	14	7	32
	2011-'18	8	10	7	25
	TOTAL	163	110	90	363
SFH	≤1920	34	60	137	231
	1921-'45	47	45	52	144
	1946-'60	34	53	49	135
	1961-'70	18	50	51	118
	1971-'80	21	66	59	146
	1981-'90	23	69	63	155
	1991-'00	20	59	56	135
	2001-'10	18	54	53	126
	2011-'18	6	21	27	55
	TOTAL	221	478	546	1,245
TOTAL		384	588	636	1,608

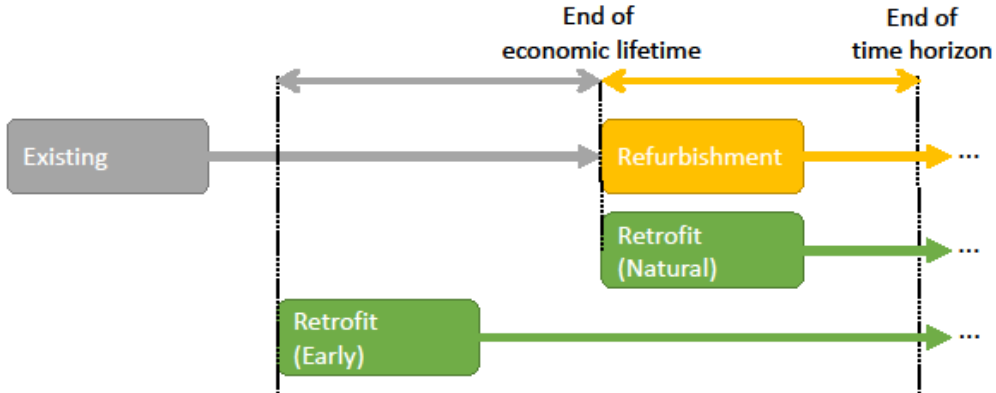
Energy Reference Area (ERA) [million m²]					
	AGE	URBAN	SUBURBAN	RURAL	TOTAL
MFH	≤1920	20	7	10	37
	1921-'45	16	3	3	22
	1946-'60	20	5	3	28
	1961-'70	22	11	5	38
	1971-'80	17	11	6	34
	1981-'90	12	10	6	27
	1991-'00	10	10	6	25
	2001-'10	13	12	5	30
	2011-'18	10	9	5	24
	TOTAL	140	77	49	266
SFH	≤1920	7	11	25	42
	1921-'45	8	7	8	22
	1946-'60	6	8	7	21
	1961-'70	3	8	7	19
	1971-'80	4	12	10	25
	1981-'90	4	12	11	28
	1991-'00	4	11	10	25
	2001-'10	3	10	10	24
	2011-'18	1	4	5	11
	TOTAL	40	83	93	216
TOTAL		179	161	142	482



Energy models

	CESAR	SwissRes
Description	dynamic energy flow simulation	steady-state energy balance
Model basis	physics	physics
Dynamics	dynamic	steady-state
Time resolution	hourly	monthly
Building archetypes	500	6,700
Model complexity	complex	simple
Data requirement	high	medium

Economic assessment

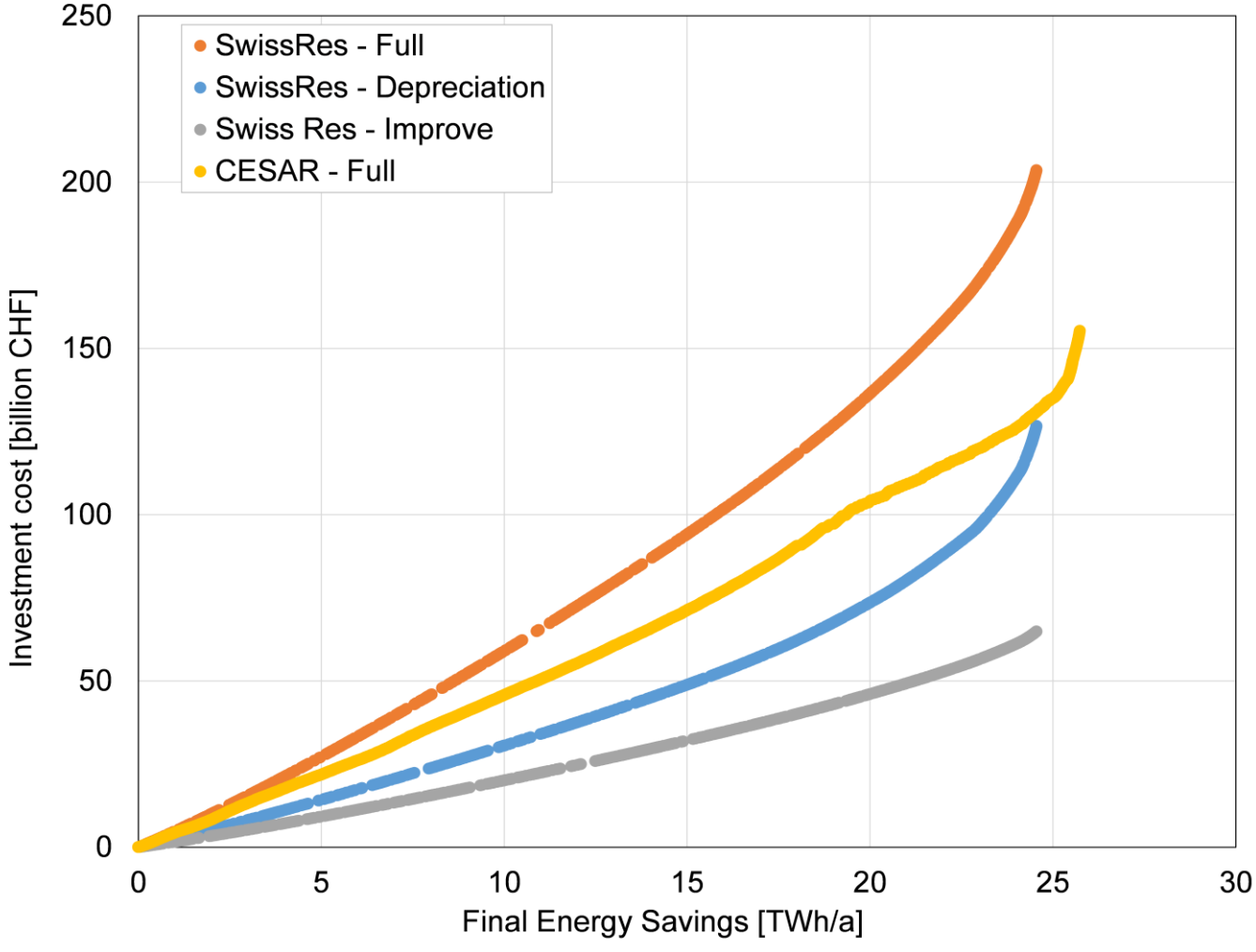


Approach	Calculation of • Investment (I) • Operational cost (OM)	Calculation of annual savings • Energy difference (ΔE) • Cost difference		Description
FULL	= Retrofit	= Existing - Retrofit	= Existing - Retrofit	Total investment cost need to be raised.
IMPROVEMENT	= Retrofit - Refurb.		= Refurb. - Retrofit	As above, but "anyway costs" are deducted. This approach implicitly assumes energy retrofit at end of life.
DEPRECIATION	= Retrofit - Refurb. + Residual f(t)	= Exisiting - Retrofit	= Refurb. - Retrofit	Considers that asset still have a value at their end of life (salvage value) and accounts for lost asset value as a consequence of early replacement.

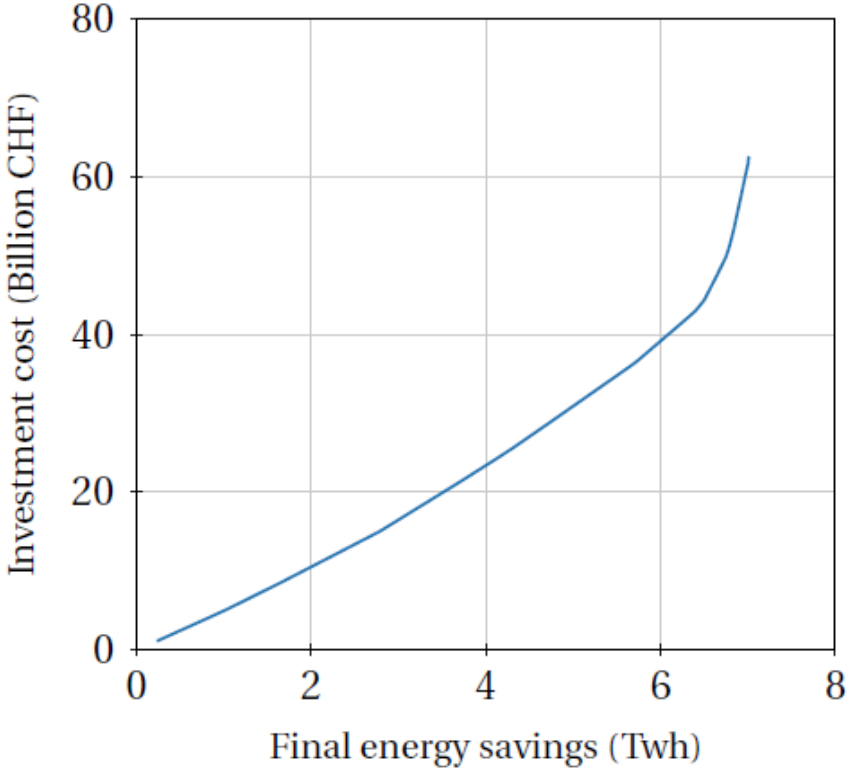
Before end of economic lifetime

After end of economic lifetime

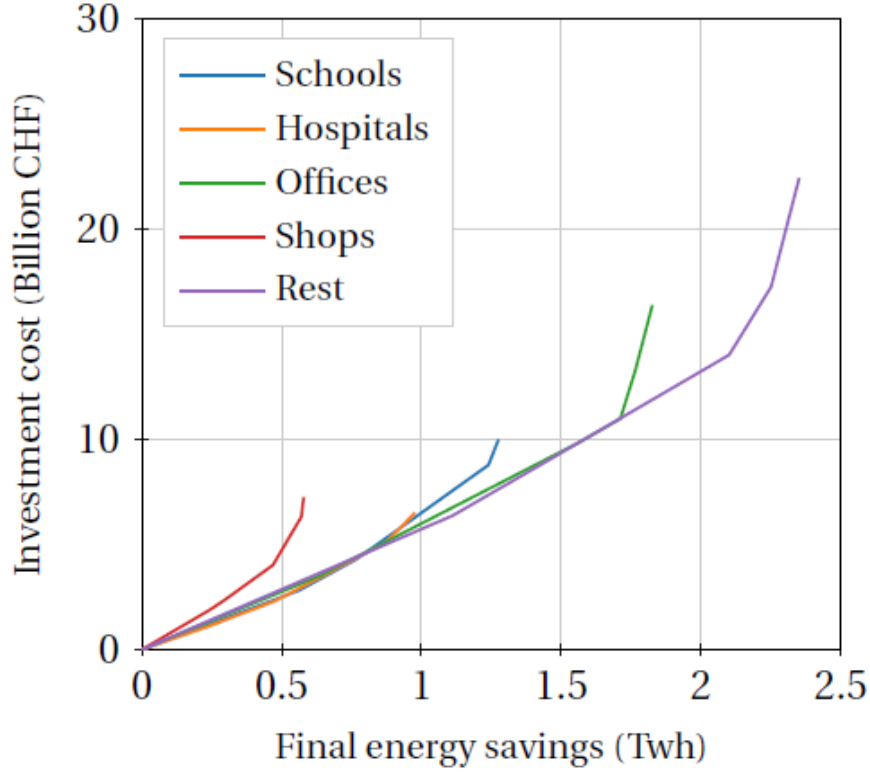
Results: Residential building stock



Results: Non-Residential building stock



(a) Full building stock



(b) By building type

Conclusion

- High reduction potential of 50% (32 TWh/a)
- But current rates (1%/a) are not sufficient
- Average full investment cost in the range of 6-8 billion CHF/a until 2050 (around 2-3 billion CHF/a improvement)
- 75% of savings are reachable with 50% of the total cost
- Very high impact of economic approach

→ Model improvements: account for additional beneftis and social restrictions

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Thank you for your attention!

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