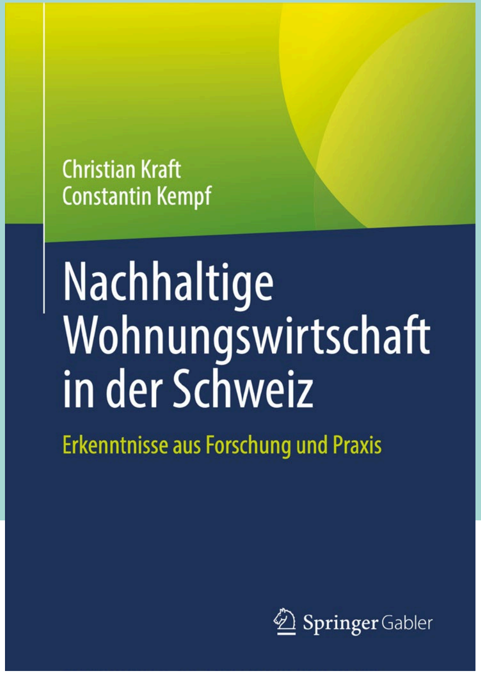
University of Basel

Construction costs and initial yield effects of MINERGIE certification and sustainable construction measures in new multi-family houses in Switzerland

Author: Constantin Kempf, 20.05.2022
Review: Dr. Robert Weinert, Wüest Partner AG



This paper is based on the book chapter:

Kraft, C., & Kempf, C. (2021). Einfluss nachhaltiger Projektattribute auf Kosten, Mieten und Werte. In *Nachhaltige Wohnungswirtschaft in der Schweiz* (pp. 79-114). Springer Gabler, Wiesbaden.

Why sustainable construction is important

The Swiss Feredal Office of Energy summarizes the impact of the Swiss building stock on the environment as follows:

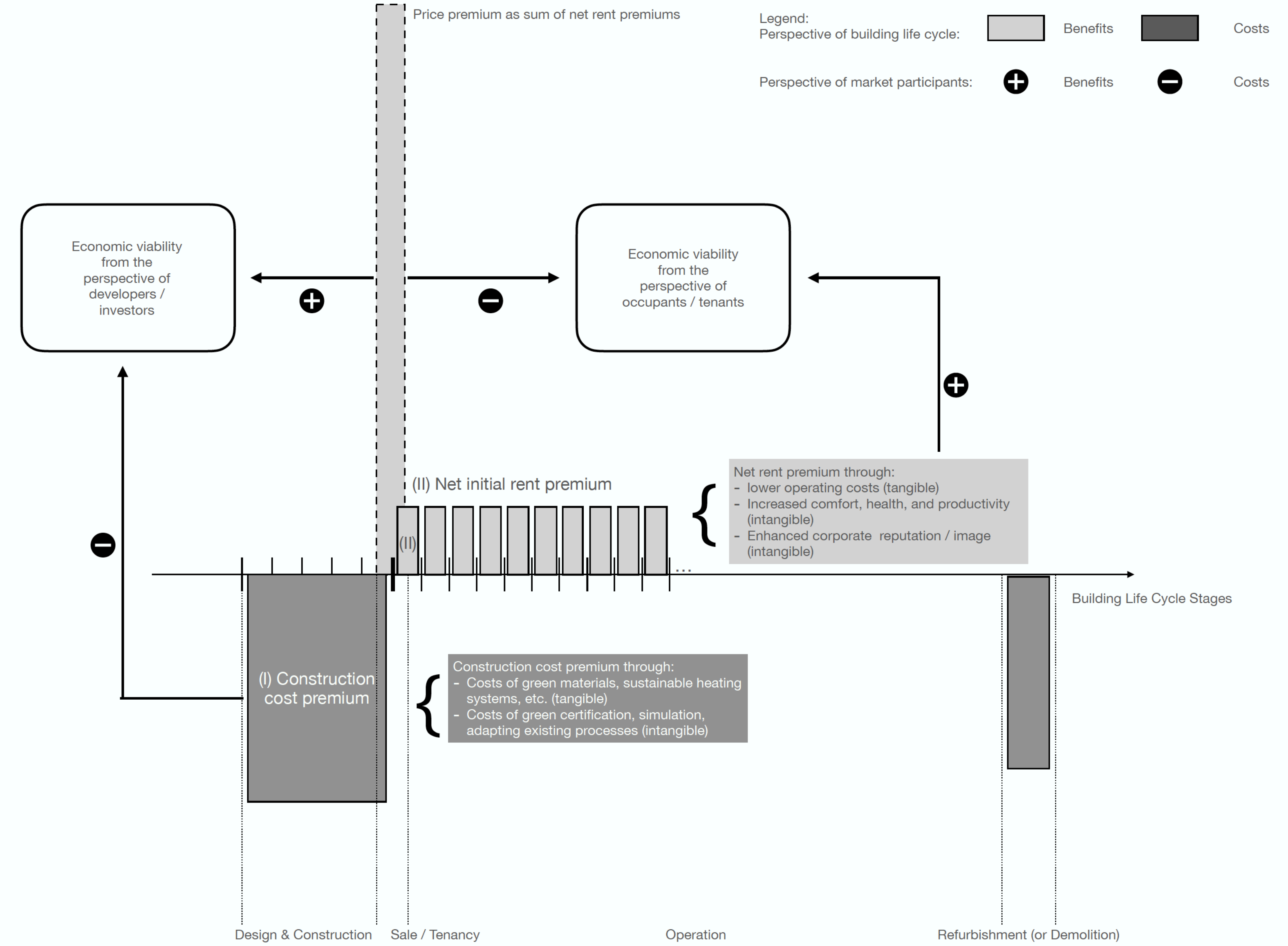
“Today, about **50 % of Switzerland’s primary energy consumption** is spent on buildings 30 % for heating, air conditioning, and hot water, 14 % for electricity, and about 6 % for manufacturing and maintenance. Exploiting the still considerable savings potential in the building sector is of great economic interest. Moreover, the building sector is also substantially responsible for the consumption of material resources, waste generation, and the environmental impact on our society (SFOE, 2020).»

→ The real estate industry has a huge impact on our environment.

However, are there economic incentives to go green?

In other words, what is the cost-benefit ratio of a green building?

Building life cycle costs and benefits based on Zhang et al. (2018)



To examine to cost-benefit ratio from the perspective of investors, we ask the questions:

(I) If green construction cost premiums during „Design & Construction phase“ exist,

and,

(II) If green measures yield higher net initial rents for the investor?

Existing Literature on Green Rent Premiums

The focus of sustainable housing research in Switzerland has been toward analyzing the rent and price premiums, that is, the revenue.

Studies by Feige et al. (2013), Marty et al. (2016), Marty & Meins (2017), Salvi et al. (2008), Salvi et al. (2010), and Schuster & Füss (2016) indicate the existence of green rent and price premiums in the approximate range between 1.78–12 %, for MINERGIE-certified buildings in the Swiss residential market.

→ The primary drivers of these higher rental and sales prices include increased quality of living, greater comfort, lower energy costs, and improved property value retention (MINERGIE, 2020).

Globally, studies by Bond & Devine (2015), Cajias et al. (2019), and Koirala et al. (2014), showed green rental and sales premiums of approximately 1.4–23.25 % according to international sustainability standards.

→ There is a **consensus** in the literature that certified buildings exert positive premiums on rents and sales.

Existing Literature on Green Cost Premiums

According to Dwaikat & Ali (2016), owners and investors often perceive sustainable buildings as expensive, which is often cited as the primary reason for the lower market penetration of green buildings.

Most studies on construction cost premiums examine the commercial sector, whereas the residential market is scarcely studied.

Overall, the literature on construction costs of sustainable buildings compared to conventional buildings identifies three different cases:

- First, studies by Kaplan et al. (2009), Matthiessen & Morris (2007), and Rehm & Ade (2013) identified **no stat. significant cost differences** in the construction of sustainable and conventional buildings.
- Second, studies by Ade & Rehm (2020), Galuppo & Tu (2010), Kim et al. (2014), Shrestha & Pushpala (2012), Zhang et al. (2011), and Kats et al. (2003), indicated **higher costs** for constructing sustainable buildings.
- Third, Lucuik et al. (2005) and Hydes & Creech (2010) identified **lower costs** for constructing a sustainable building.

In contrast to the predominantly positive benefits of sustainable building labels on rents and prices, the cost-side effects of green certified real estate are still **ambiguous**.

Hypotheses

Based on these identified gaps in the existing literature, this study addresses the following hypotheses:

Sustainable residential properties exert

(I) higher construction costs and
(II) higher initial rental income,

compared to conventional properties.

Additionally, we study the effects of cost of and return to certification (according to MINERGIE) and that of its underlying building measures and parts that lead to certification.

What we define as “green“ and where the data comes from

We define «greenness» in two ways:

First, the analysis distinguishes between **individual construction measures that lead to certification**, i.e., *technology controls*, and *amenity and quality controls* that are independent form certification status.

→ For example, the analysis compares the construction costs and net initial rents of clean technology such as geothermal energy, which is in line with the certification standard, against conventional fossil-based heating, that is not allowed for certification. Therefore, the analysis reveals the cost and rent premiums from the construction measure level.

Second, hedonic regression specifications include whether a project was **certified according to a certain MINERGIE standard** or not.

→ Thus, the study addressed whether premiums on construction costs and net rents can be ascribed to MINERGIE, which demands a bundle of sustainable characteristics (MINERGIE, 2022).

Data:
This study assembles a new dataset including specific information on construction projects and their costs (Baublatt/Bauinfo-Center Docu Media, 2020), linked with listing data (FPRE, 2020) on the net initial rents of projects, and information on MINERGIE (2021) certifications.

Methodology – Hedonic Regression

(I) $$ln(Construction\ costs\ per\ m^2) = c_0 + \beta z_i + \gamma l_i + \phi t_i + \epsilon_i,$$

(II) $$ln(Net\ rent\ per\ m^2\ and\ year_i) = c_0 + \beta z_i + \gamma l_i + \phi t_i + \epsilon_i,$$

where:

c_0 = constant

β, γ, ϕ = vectors of regression coefficients or implicit hedonic prices

z_i = z_i vector of structural variables market, project size, and individual components of the construction project:

- **MINERGIE**
  MINERGIE Y/N
  MINERGIE, "MINERGIE-P or higher"
- **Market**
  Owner-occupied property market (=dummy variable), rental market and total market (both)
- **Size**
  ln(Number of apartments)
  ln(Square area per project)
  ln(Storeys)
  ln(Mean net floor area)
  ln(Mean number of rooms)
- **Individual components of construction project (cf. Appendix A)**

l_i = l_i vector of locational variables of construction project:

- Mobilité Spatiale regions: 1 to 106, reference category = MS 1 (City of Zurich)
- Accessibility by public transport "ÖV-Güteklasse", A, B, C, D, none (=reference category)
- Population density per hectare: Permanent population, total per hectare

t_i = t_i vector of time trend variable of construction project:

- Year 2010 to 2020 (reference category = 2010), year in which the construction application was approved

ϵ_i = Error term

→ Estimation equation = Hedonic Regression (I) & (II), reflecting our hypotheses. (standard methodology)

Ingredients of hedonic model:

→ Structural Variables

→ Locational Variables

→ Time Trend Variable

Certificates and individual components of construction project

Appendix A: Individual components of construction project

B) technology controls that lead to certification
C) amenity controls independent from certification
Reference category (amenity controls in grey), if amenity controls are not included. See specifications [I], [V], and [VI]
Reference category (italic), if amenity controls are included for regression specifications [II], [VII], and [VIII]

Roofing
MINERGIE standard
Reference category = all others

Roofing finishes
Green roofing
Reference category = all others

Façade
MINERGIE standard
Wood
Metal/steel/light metal
Natural stone
Glass
Façade elements: concrete/lightweight concrete/artificial stone
Ventilated curtain façades
Fiber cement plates
Ceramic
Exposed masonry/brickwork
Sandwich panels
Exposed concrete
Compact façades
Façades without specifications
Reference category = Plastered masonry/brickwork

Windows
Minergie standard
Wood windows
Metal/lightweight metal windows
Thermal and acoustic insulated windows
Balcony and terrace windows
Wood/metal windows
Windows without specifications
Reference category = Plastic windows

Electricity
Solar energy
Reference category = all others

Supporting Structure
Wood
Brick
Aerated concrete blocks
Sand-lime brick
Skeleton consruction (concrete, steel, wood)
Steel
Double-shell masonry/brickwork
Exposed masonry/brickwork
Single-layer masonry/brickwork
Supporting structure without specifications
Reference category = Concrete

Heating
District heating
Heat pumps
Solar heating systems
Geothermal energy/ground probes/collectors
Wood-fired heating
Woodchip heating
Pellet heating
Controlled room ventilation/comfort ventilation
Gas-fired heating
Electric heating
Chimney/Chimney stove
Floor heating
Radiators/Flat panel radiators
Heating without specifications
Reference category = Oil-fired heating

Insulation
Minergie standard
Internal thermal insulation
External thermal insulation
In-between thermal insulation
Thermal insulation of earth-contacting components
Insulation and seal without specifications
Reference category = all others

Flooring
Floor underlay
Artificial stone flooring
Parquet flooring
Linoleum flooring/synthetic flooring
Textile flooring
Ceramic flooring
Wooden flooring
Concrete flooring
Raised/false flooring
Natural stone flooring
Laminate flooring
Industrial jointless flooring
Reference category = all others

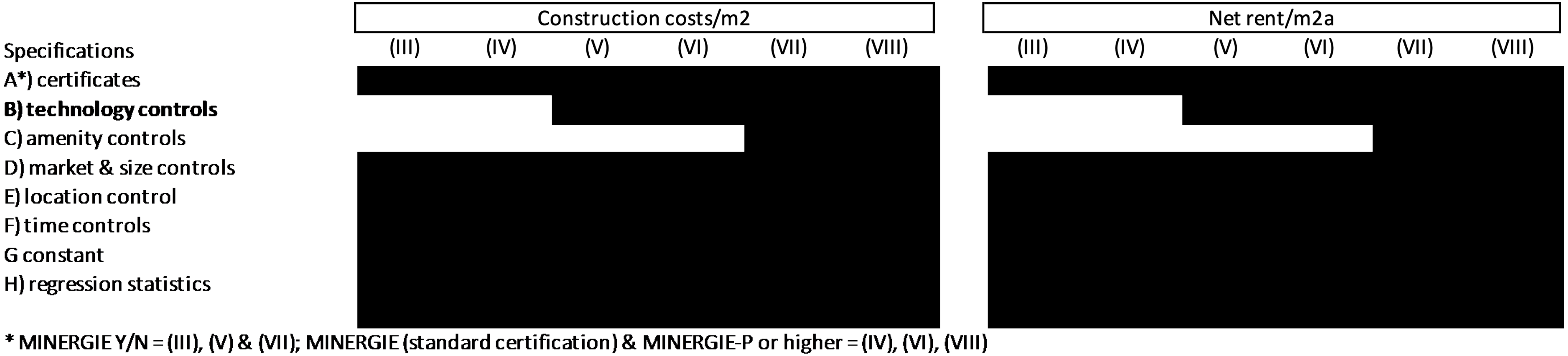
Interior
Not differentiated

Equipment
Air conditioner
Conveyor system
Sun and weather protection
Building automation
Safety technology
Garage gate
Landscaping
Cooling systems
Tank installations (areas with heating)
Terraces/balconies
Ventilation
Habitat/pond
Pergola
External lighting
Irrigation system
Controlled parking system
Reference category = all others

- List of building measures and components, for which we control in our model:

- [A) Certificates: MINERGIE Y/N & MINERGIE (standard certification) and MINERGIE-P or higher]
- **B) Technology controls that lead to (MINERGIE) certification**
- C) Amenity and quality controls that are independent from certification status.

Model Specifications



- The analysis begins by running a model that omits the key technology controls that lead to certification and only includes the certification (cf. Specifications (III)-(IV)).

- Adding the key technology controls to the regression reveals the total cost or return to certification and how much of that cost or return is explained by adding the observable environmental investments that lead to certification (III)-(VI).

- Finally, there are further quality and amenity controls, which are independent from certification status (but correlated with certified buidings). Adding these extra controls further erodes the estimates on certification. Compare (III)-(VI) vs. (VII)-(VIII).

Estimation results

The analysis of the cost-benefit ratio reveals the following:

- First, sign. cost and rent premiums for MINERGIE certifications identified.
- Second, cost and rent premiums for MINERGIE certifications erode but persist.
- Third, results on MINERGIE premiums align with literature.
- Fourth, significant construction cost premiums for (green) technology controls, but almost no effect on yields (except geothermal energy).

OLS			Construction costs/m2						Net rent/m2a					
Specifications			(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Dependent Variable			ln(Construction costs/m2)						ln(Net rent/m2a)					
Structural Variables														
A) certificates	Certificates	**MINERGIE Y/N**	0.0251***		0.0220***		0.0187**		0.0358***		0.0351***		0.0296**	
	Ref. Cat. =		(0.0079)		(0.0079)		(0.0077)		(0.0122)		(0.0124)		(0.0125)	
	Non-certified buildings													
		MINERGIE		0.0219***		0.0189**		0.0157*		0.0312**		0.0309**		0.0254**
				(0.0082)		(0.0082)		(0.0081)		(0.0128)		(0.0131)		(0.0129)
		MINERGIE-P or higher		0.0577**		0.0535**		0.0496**		0.0733*		0.0696*		0.0637
				(0.0244)		(0.0246)		(0.0241)		(0.0379)		(0.0383)		(0.0454)
B) technology controls	Roofing	**MINERGIE standard**			0.0256	0.0254	0.0186	0.0183			0.1231	0.119	0.0907	0.0873
	Ref. Cat. = cf. Appendix				(0.0313)	(0.0313)	(0.0309)	(0.0309)			(0.2074)	(0.2079)	(0.1962)	(0.1966)
	Façade	**MINERGIE standard**			0.0318	0.0329	0.0095	0.0102			-0.0801	-0.0823	-0.0896	-0.0916
	Ref. Cat. = cf. Appendix				(0.0355)	(0.0355)	(0.0364)	(0.0364)			(0.0747)	(0.0745)	(0.0670)	(0.0670)
	Windows	**Minergie standard**			-0.0593	-0.0592	-0.0683	-0.0682			-0.0623	-0.0564	-0.0457	-0.0398
	Ref. Cat. = cf. Appendix				(0.0451)	(0.0451)	(0.0439)	(0.0438)			(0.0877)	(0.0884)	(0.0811)	(0.0821)
	Heating	**District heating**			0.0273***	0.0273***	0.0484***	0.0487***			-0.0156	-0.0157	0.0021	0.0017
	Ref. Cat. = cf. Appendix				(0.0094)	(0.0094)	(0.0135)	(0.0135)			(0.0132)	(0.0132)	(0.0214)	(0.0214)
		Heat pumps			-0.0036	-0.0035	0.0278**	0.0280**			-0.0031	-0.003	0.0182	0.0179
					(0.0064)	(0.0064)	(0.0120)	(0.0120)			(0.0089)	(0.0089)	(0.0191)	(0.0191)
		Solar heating systems			-0.0006	-0.0006	0.0061	0.0061			0.0049	0.0048	-0.0024	-0.0026
					(0.0069)	(0.0069)	(0.0071)	(0.0071)			(0.0107)	(0.0107)	(0.0110)	(0.0110)
		Geothermal energy/ground probes/ collectors			0.0368***	0.0367***	0.0310***	0.0310***			0.0255***	0.0255***	0.0191**	0.0191**
					(0.0059)	(0.0059)	(0.0058)	(0.0058)			(0.0089)	(0.0089)	(0.0088)	(0.0088)
		Wood-fired heating			0.0103	0.0104	0.0283	0.0285			-0.0195	-0.0197	-0.0102	-0.0106
					(0.0174)	(0.0174)	(0.0189)	(0.0189)			(0.0311)	(0.0311)	(0.0316)	(0.0316)
		Woodchip heating			0.0308	0.0307	0.0498**	0.0498**			-0.0262	-0.0254	0.0084	0.0091
					(0.0234)	(0.0234)	(0.0239)	(0.0239)			(0.0332)	(0.0333)	(0.0341)	(0.0343)
		Pellet heating			0.0390**	0.0392**	0.0594***	0.0597***			-0.016	-0.0153	0.0046	0.0049
					(0.0154)	(0.0154)	(0.0173)	(0.0173)			(0.0195)	(0.0196)	(0.0241)	(0.0241)
		Controlled room ventilation/ comfort ventilation			0.0174*	0.0177*	0.0171*	0.0175*			0.0107	0.0108	0.0032	0.0033
					(0.0099)	(0.0100)	(0.0099)	(0.0099)			(0.0136)	(0.0136)	(0.0134)	(0.0134)
	Insulation	**Minergie standard insulation**			0.0206	0.019	0.0529*	0.0520*			0.0164	0.0164	0.0329	0.0319
	Ref. Cat. = cf. Appendix				(0.0219)	(0.0220)	(0.0281)	(0.0282)			(0.0723)	(0.0722)	(0.0817)	(0.0817)
	Electricity	**Solar energy (Electricity)**			0.0299***	0.0298***	0.0246***	0.0246***			-0.0078	-0.0076	-0.0011	-0.0009
	Ref. Cat. = all others				(0.0080)	(0.0080)	(0.0080)	(0.0080)			(0.0150)	(0.0150)	(0.0148)	(0.0148)
C) amenity controls							**Appendix**	**Appendix**					**Appendix**	**Appendix**

Conclusion I/II

- This study investigated whether (I) sustainable residential multi-family dwellings exhibit higher construction costs and (II) increased net initial rents compared to conventionally constructed buildings.
- Further, the analysis helps understanding the cost of and return to certification (MINERGIE) including the underlying components of green buildings (technology that leads to certification & quality and amenity controls).

(I) Construction Costs:

- The analysis showed that after controlling for technology and amenity, a statistically significant cost premium for MINERGIE certification persists.
- Besides, sustainable technology that leads to certification, also the MINERGIE certification itself, demands a statistically significant cost premium of about 1.9 % (1.6 % or MINERGIE (standard certification) and 5.1% for MINERGIE-P or higher).

- The empirical results showed statistically significant cost premiums for the sustainable construction measures:
  - 5.0 % for district heating,
  - 3.1 % for geothermal energy with the reference category oil-fired heating,
  - 3.2 % for green roofing over other roofing finishes (cf. specification [VIII] in Appendix B).

- In general, higher costs occurred for specific sustainable construction measures and MINERGIE certifications.

Conclusion II/II

(II) Net initial rents

- With a few exceptions (geoth. energy), no statistically significant effects on net initial rents were identified for the individual green building measures.
- For MINERGIE, the results were different. The certifications of MINERGIE (standard certification) and MINERGIE-P or higher yielded increased net initial rents of 2.6% and 6.6% (not significant) for apartments.
- However, the analysis showed that environmental friendly technology (technology controls) does not impact net initial rents significantly. In contrast, high-quality materials and amenities (e.g. glass façade, elevator, green roofing) which deliver a perceptible benefit to tenants, show statistically significant rental premiums.

→ These results suggested that green building practices without labels or certifications were not rewarded by the market through increased rents.

→ The implementations require credible labels, such as a MINERGIE certification to yield a green rent premium. This aligned with Bond & Devine (2015), that certification transmits a stronger signal than just stating that a property is green.

→ As this analysis focused on construction costs and their initial returns, rather than concentrating on the perspective of a holistic life cycle costs and return approach, it shows that there might be a discrepancy between costs and return with respect to single construction measures in the short run.

→ The results suggest that the certification according to MINERGIE could soften this myopic incentive problem in Switzerland.

→ For further research: A full cost and return consideration of sustainable construction measures (and MINERGIE certification) would certainly be worthwile.

University of Basel

Thank you
for your attention.

Literature I/II

- Ade, R., & Rehm, M. (2020). Reaching for the stars: green construction cost premiums for homestar certification. Construction Management and Economics, 38, 570–580.
- Baublatt/Bauinfo-Center Docu Media (2020). Data on planning applications.
- Bond, S. A., & Devine, A. (2015). Certification matters: Is green talk cheap talk? The Journal of Real Estate Finance and Economics, 52, 117–140. doi:10.1007/s11146-015-9499-y.
- Cajias, M., Fuerst, F., & Bienert, S. (2019). Tearing down the information barrier: the price impacts of energy efficiency ratings for buildings in the german rental market. Energy Research & Social Science, 47, 177–191.
- Dwaikat, L. N., & Ali, K. N. (2016). Green buildings cost premium: A review of empirical evidence. Energy and Buildings, 110, 396–403. URL: https://linkinghub.elsevier.com/retrieve/pii/S0378778815303856.doi:10.1016/j.enbuild.2015.11.021.
- Feige, A.,Mcallister, P., &Wallbaum, H. (2013). Rental price and sustainability ratings: which sustainability criteria are really paying back? Construction Management and Economics, 31, 322–334. Number: 4.
- FPRE (2020). Listing data on initial net rents from fahrländer partner ag (fpre).
- Galuppo, L., & Tu, C. (2010). Capital markets and sustainable real estate: what are the perceived risks and barriers? Journal of Sustainable Real Estate, 2, 143–159. Number: 1 ISBN: 1949-8276 Publisher: American Real Estate Society.
- Hydes, K. R., & Creech, L. (2010). Reducing mechanical equipment cost: the economics of green design. Building Research & Information, 28, 403–407. Number: 5-6 ISBN: 0961-3218 Publisher: Taylor & Francis
- Kaplan, S., Crawford, J., Dubin, M., Knops, P., Leigh, R., Matthiessen, L. F., Rios, J., Rudin, M., Sparko, A., & Unger, R. (2009). Cost of green in nyc. US Green Building Council Chapter (Ed.). New York Urban Green Council.
- Kats, G., Alevantis, L., Berman, A., Mills, E., & Perlman, J. (2003). The costs and financial benefits of green buildings: a report to California's sustainable building task force, . Publisher: Capital E Washington, DC.
- Kraft, C., & Kempf, C. (2021). *Nachhaltige Wohnungswirtschaft in der Schweiz - Erkenntnisse aus Forschung und Praxis*. Springer Gabler.
- Lucuik, M., Trusty, W., Larsson, N., & Charette, R. (2005). A Business Case for Green Building in Canada: Presented to Industry Canada. Retrieved July, 12, 2009.
- Kim, J.-L., Greene, M., & Kim, S. (2014). Cost comparative analysis of a new green building code for residential project development. Journal of construction engineering and management, 140, 05014002
- Koirala, B. S., Bohara, A. K., & Berrens, R. P. (2014). Estimating the net implicit price of energy efficient building codes on u.s. households. Energy Policy, 73, 667–675. doi:10.1016/j.enpol.2014.06.022.
- Marty, R., Meins, E., & Bächinger, C. (2016). Sustainability and real estate rental rates: Empirical evidence for Switzerland Universität Zürich. CCRSWorking Paper Series, . URL: https://www.ccrs.uzh.ch/dam/jcr:638b1f03-3f89-4acd-8e5a-7bc84d80a2bd/2016wp01.pdf.

Literature II/II

- Marty, R., & Meins, E. (2017). Der Schweizer Mietimmobilienmarkt belohnt andere Nachhaltigkeitsmerkmale als Energieeffizienz. Swiss Real Estate Journal, 15, 47–54. Publisher: Schulthess Juristische Medien AG.
- Matthiessen, L. F., & Morris, P. (2007). Cost of green revisited: Reexamining the feasibility and cost impact of sustainable design in the light of increased market adoption. Continental Automated Buildings Association.
- MINERGIE (2020). Finanzielle Vorteile. URL: https://www.minergie.ch/de/ueber-minergie/unsere-themen/finanzielle-vorteile/.
- MINERGIE (2021). MINERGIE - aktuelle Gebäudeliste. URL: https://www.minergie.ch/de/gebaeude/gebaeudeliste/.
- MINERGIE (2022). Mit minergie zertifizieren. URL: https://www.minergie.ch/de/zertifizieren/minergie/.
- Rehm, M., & Ade, R. (2013). Construction costs comparison between 'green' and conventional office buildings. Building Research & Information, 41, 198–208. URL: https://doi.org/10.1080/09613218.2013.769145.doi:10.1080/09613218.2013.769145. Number: 2 Publisher: Routledge _eprint: https://doi.org/10.1080/09613218.2013.769145
- Salvi, M., Horehájová, A., & Müri, R. (2008). Der Nachhaltigkeit von Immobilien einen finanziellen Wert geben–Minergie macht sich bezahlt. Center for Corporate Responsibility and Sustainability, Universität Zürich, Zürich. Abrufbar unter www.ccrs.uzh.ch.
- SFOE (2020). Energie in Gebäuden. https://www.bfe.admin.ch/bfe/de/home/versorgung/energieeffizienz/energie-in-gebaeuden.html. Zugegriffen: 20. Juli 2020.
- Shrestha, P. P., & Pushpala, N. (2012). Green and Non-Green School Buildings: An Empirical Comparison of Construction Cost and Schedule, . (pp. 1820–1829). URL: https://ascelibrary.org/doi/abs/10.1061/9780784412329.183.doi:10.1061/9780784412329.183. ISBN: 9780784412329 Publisher: American Society of Civil Engineers.
- Schuster, T., & Füss, R. (2016). Mietprämien von MINERGIE-Gebäuden im Immobilienmarkt Schweiz, Publisher: Universität St. Gallen.
- Zhang, L.,Wu, J., & Liu, H. (2018). Turning green into gold: A review on the economics of green buildings. Journal of cleaner production, 172, 2234–2245.
- Zhang, X., Platten, A., & Shen, L. (2011). Green property development practice in China: Costs and barriers. Building and environment, 46, 2153–2160. Number: 11 ISBN: 0360-1323 Publisher: Elsevier.

Appendix I/II

Table 7: Regression results of construction costs/m^2

Specifications (I) (II) (III) (IV) (V) (VI) (VII) (VIII)
A) certificates
B) technology controls
C) amenity controls
D) market & size controls
E) location control
F) time controls
G constant
H) regression statistics

Block	Line	Category	Variable	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
		OLS		Construction costs/m2							
		Specifications		(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
		Dependent Variable		ln(Construction costs/m2)							
	Line:	**Structural Variables**									
A) certificates	a	Certificates	MINERGIE Y/N			0.0251***		0.0220***		0.0187**	
		Ref. Cat. = Non-certified buildings				(0.0079)		(0.0079)		(0.0077)	
	b		MINERGIE				0.0219***		0.0189**		0.0157*
							(0.0082)		(0.0082)		(0.0081)
	c		MINERGIE-P or higher				0.0577**		0.0535**		0.0496**
							(0.0244)		(0.0246)		(0.0241)
B) technology controls	d	Roofing	**MINERGIE standard**	0.0257	0.0184			0.0256	0.0254	0.0186	0.0183
		Ref. Cat. = all others		(0.0314)	(0.0310)			(0.0313)	(0.0313)	(0.0309)	(0.0309)
	e	Façade	**MINERGIE standard**	0.0315	0.0090			0.0318	0.0329	0.0095	0.0102
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Plastered masonry/brickwork for Spec. (2), (7) & (8)		(0.0356)	(0.0365)			(0.0355)	(0.0355)	(0.0364)	(0.0364)
	f	Windows	**Minergie standard**	-0.0594	-0.0685			-0.0593	-0.0592	-0.0683	-0.0682
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Plastic windows for Spec. (2), (7) & (8)		(0.0450)	(0.0438)			(0.0451)	(0.0451)	(0.0439)	(0.0438)
	g	Heating	**District heating**	0.0277***	0.0489***			0.0273***	0.0273***	0.0484***	0.0487***
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Oil-fired heating for Spec. (2), (7) & (8)		(0.0094)	(0.0135)			(0.0094)	(0.0094)	(0.0135)	(0.0135)
	h		**Heat pumps**	-0.0033	0.0281**			-0.0036	-0.0035	0.0278**	0.0280**
				(0.0064)	(0.0120)			(0.0064)	(0.0064)	(0.0120)	(0.0120)
	i		**Solar heating systems**	-0.0008	0.006			-0.0006	-0.0006	0.0061	0.0061
				(0.0069)	(0.0071)			(0.0069)	(0.0069)	(0.0071)	(0.0071)
	j		**Geothermal energy/ground probes/ collectors**	0.0369***	0.0311***			0.0368***	0.0367***	0.0310***	0.0310***
				(0.0059)	(0.0058)			(0.0059)	(0.0059)	(0.0058)	(0.0058)
	k		**Wood-fired heating**	0.0097	0.0279			0.0103	0.0104	0.0283	0.0285
				(0.0174)	(0.0189)			(0.0174)	(0.0174)	(0.0189)	(0.0189)
	l		**Woodchip heating**	0.0313	0.0504**			0.0308	0.0307	0.0498**	0.0498**
				(0.0235)	(0.0239)			(0.0234)	(0.0234)	(0.0239)	(0.0239)
	m		**Pellet heating**	0.0392**	0.0596***			0.0390**	0.0392**	0.0594***	0.0597***
				(0.0154)	(0.0173)			(0.0154)	(0.0154)	(0.0173)	(0.0173)
	n		**Controlled room ventilation/ comfort ventilation**	0.0184*	0.0180*			0.0174*	0.0177*	0.0171*	0.0175*
				(0.0099)	(0.0099)			(0.0099)	(0.0100)	(0.0099)	(0.0099)
	o	Insulation	**Minergie standard insulation**	0.0217	0.0545*			0.0206	0.019	0.0529*	0.0520*
		Ref. Cat. = all, but MINERGIE standard for Spec. (1), (5) & (6) Ref. Cat. = all others (2), (7) & (8)		(0.0219)	(0.0281)			(0.0219)	(0.0220)	(0.0281)	(0.0282)
	p	Electricity	**Solar energy (Electricity)**	0.0300***	0.0247***			0.0299***	0.0298***	0.0246***	0.0246***
		Ref. Cat. = all others		(0.0080)	(0.0080)			(0.0080)	(0.0080)	(0.0080)	(0.0080)
C) amenity controls					Appendix B					Appendix B	Appendix B
D) market & size controls	q	Market	Owner-occupied property	0.0384***	0.0356***	0.0392***	0.0392***	0.0382***	0.0382***	0.0354***	0.0355***
				(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)
	r	Size	ln(Number of apartments)	0.2262***	0.2504***	0.2250***	0.2250***	0.2262***	0.2263***	0.2504***	0.2505***
				(0.0095)	(0.0098)	(0.0095)	(0.0095)	(0.0095)	(0.0095)	(0.0097)	(0.0097)
	s		ln(Square area per project [m2])	-0.3125***	-0.3506***	-0.3079***	-0.3079***	-0.3127***	-0.3127***	-0.3508***	-0.3509***
				(0.0093)	(0.0103)	(0.0093)	(0.0093)	(0.0093)	(0.0093)	(0.0103)	(0.0102)
	t		ln(Storeys)	0.0390***	0.0232**	0.0386***	0.0384***	0.0389***	0.0388***	0.0231**	0.0229**
				(0.0095)	(0.0096)	(0.0095)	(0.0095)	(0.0095)	(0.0095)	(0.0096)	(0.0096)
	u		ln(Mean net floor area)								
	v		ln(Mean number of rooms)								
E) location controls		**Locational variables**									
	w	Mobilité Spatiale regions		y	y	y	y	y	y	y	y
	x	Location Class "ÖV-Güteklasse"		y	Appendix B	y	y	y	y	Appendix B	Appendix B
	y	Population density per hectar		y	Appendix B	y	y	y	y	Appendix B	Appendix B
F) time control		**Time Fixed Effects**									
	z	Year of building application		y	Appendix B	y	y	y	y	Appendix B	Appendix B
G) constant			Constant	9.4336***	9.6325***	9.4279***	9.4285***	9.4330***	9.4334***	9.6331***	9.6344***
			20	-0.0567	(0.1323)	-0.0565	-0.0565	-0.0567	-0.0567	(0.1324)	(0.1324)
H) regression statistics		N		11,993	11,993	11,993	11,993	11,993	11,993	11,993	11,993
		R2		0.2913	0.321	0.2869	0.287	0.2918	0.2919	0.3214	0.3215
		Adjusted R2		0.2831	0.3092	0.2793	0.2794	0.2835	0.2836	0.3095	0.3095
		Residual Std. Error		0.2422 (df = 11855)	0.2378 (df = 11786)	0.2428 (df = 11867)	0.2428 (df = 11866)	0.2421 (df = 11854)	0.2421 (df = 11853)	0.2377 (df = 11785)	0.2377 (df = 11784)
		F Statistic		35.5703*** (df = 137; 11855)	27.0538*** (df = 206; 11786)	38.1877*** (df = 125; 11867)	37.9018*** (df = 126; 11866)	35.3869*** (df = 138; 11854)	35.1468*** (df = 139; 11853)	26.9608*** (df = 207; 11785)	26.8409*** (df = 208; 11784)

Source: Own representation, data from ARE (2020b), Baublatt/Bauinfo-Center Docu Media (2020), FSO (2018), FPRE (2020), MINERGIE (2021).

Note: White heteroskedasticity-consistent (robust) standard errors HC1 are clustered for each location cluster within parenthesis. Significance values 0.10, 0.05, and 0.01 are indicated by *, ** and ***, respectively.

Table 8: Regression results net rent/m^2a

Specifications I II III IV V VI VII VIII
A) certificates
B) technology controls
C) amenity controls
D) market & size controls
E) location control
F) time controls
G constant
H) regression statistics

Block	Line	Category	Variable	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
		OLS		Net rent/m2a							
		Specifications		(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
		Dependent Variable		ln(Net rent/m2a)							
	Line:	**Structural Variables**									
A) certificates	a	Certificates	MINERGIE Y/N			0.0358***		0.0351***		0.0296**	
		Ref. Cat. = Non-certified buildings				-0.0122		-0.0124		(0.0125)	
	b		MINERGIE				0.0312**		0.0309**		0.0254**
							(0.0128)		(0.0131)		(0.0129)
	c		MINERGIE-P or higher				0.0733*		0.0696*		0.0637
							(0.0379)		(0.0383)		(0.0454)
B) technology controls	d	Roofing	**MINERGIE standard**	0.1221	0.0908			0.1231	0.119	0.0907	0.0873
		Ref. Cat. = all others		(0.2082)	(0.1963)			(0.2074)	(0.2079)	(0.1962)	(0.1966)
	e	Façade	**MINERGIE standard**	-0.0785	-0.0883			-0.0801	-0.0823	-0.0896	-0.0916
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Plastered masonry/brickwork for Spec. (2), (7) & (8)		(0.0753)	(0.0673)			(0.0747)	(0.0745)	(0.0670)	(0.0670)
	f	Windows	**Minergie standard**	-0.0649	-0.048			-0.0623	-0.0564	-0.0457	-0.0398
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Plastic windows for Spec. (2), (7) & (8)		(0.0887)	(0.0815)			(0.0877)	(0.0884)	(0.0811)	(0.0821)
	g	Heating	**District heating**	-0.0139	0.0038			-0.0156	-0.0157	0.0021	0.0017
		Ref. Cat. = all others for Spec. (1), (5) & (6) Ref. Cat. = Oil-fired heating for Spec. (2), (7) & (8)		(0.0132)	(0.0213)			(0.0132)	(0.0132)	(0.0214)	(0.0214)
	h		**Heat pumps**	-0.0022	0.0193			-0.0031	-0.003	0.0182	0.0179
				(0.0089)	(0.0191)			(0.0089)	(0.0089)	(0.0191)	(0.0191)
	i		**Solar heating systems**	0.0047	-0.0028			0.0049	0.0048	-0.0024	-0.0026
				(0.0107)	(0.0110)			(0.0107)	(0.0107)	(0.0110)	(0.0110)
	j		**Geothermal energy/ground probes/ collectors**	0.0256***	0.0192**			0.0255***	0.0255***	0.0191**	0.0191**
				(0.0089)	(0.0088)			(0.0089)	(0.0089)	(0.0088)	(0.0088)
	k		**Wood-fired heating**	-0.0216	-0.0119			-0.0195	-0.0197	-0.0102	-0.0106
				(0.0311)	(0.0316)			(0.0311)	(0.0311)	(0.0316)	(0.0316)
	l		**Woodchip heating**	-0.0221	0.0123			-0.0262	-0.0254	0.0084	0.0091
				(0.0345)	(0.0353)			(0.0332)	(0.0333)	(0.0341)	(0.0343)
	m		**Pellet heating**	-0.013	0.0075			-0.016	-0.0153	0.0046	0.0049
				(0.0198)	(0.0242)			(0.0195)	(0.0196)	(0.0241)	(0.0241)
	n		**Controlled room ventilation/ comfort ventilation**	0.0128	0.005			0.0107	0.0108	0.0032	0.0033
				(0.0135)	(0.0133)			(0.0136)	(0.0136)	(0.0134)	(0.0134)
	o	Insulation	**Minergie standard insulation**	0.0189	0.034			0.0164	0.0164	0.0329	0.0319
		Ref. Cat. = all, but MINERGIE standard for Spec. (1), (5) & (6) Ref. Cat. = all others (2), (7) & (8)		(0.0729)	(0.0826)			(0.0723)	(0.0722)	(0.0817)	(0.0817)
	p	Electricity	**Solar energy (Electricity)**	-0.0074	-0.0008			-0.0078	-0.0076	-0.0011	-0.0009
		Ref. Cat. = all others		(0.0149)	(0.0148)			(0.0150)	(0.0150)	(0.0148)	(0.0148)
C) amenity controls					Appendix B					Appendix B	Appendix B
D) market & size controls	q	Market	Owner-occupied property	0.0096	-0.0011	0.0098	0.0097	0.0092	0.0091	-0.0014	-0.0015
				(0.0074)	(0.0077)	(0.0074)	(0.0074)	(0.0074)	(0.0074)	(0.0077)	(0.0077)
	r	Size	ln(Number of apartments)	-0.0195***	-0.0306***	-0.0207***	-0.0207***	-0.0201***	-0.0201***	-0.0311***	-0.0311***
				(0.0047)	(0.0051)	(0.0045)	(0.0045)	(0.0047)	(0.0047)	(0.0051)	(0.0051)
	s		ln(Square area per project [m2])								
	t		ln(Storeys)	0.015	0.008	0.012	0.0119	0.0148	0.0147	0.0078	0.0077
				(0.0136)	(0.0139)	(0.0134)	(0.0134)	(0.0136)	(0.0136)	(0.0139)	(0.0139)
	u		ln(Mean net floor area)	-0.3293***	-0.3484***	-0.3244***	-0.3242***	-0.3293***	-0.3291***	-0.3483***	-0.3481***
				(0.0228)	(0.0228)	(0.0229)	(0.0229)	(0.0228)	(0.0228)	(0.0228)	(0.0228)
	v		ln(Mean number of rooms)	0.0388	0.0498*	0.0373	0.0374	0.0382	0.0382	0.0491*	0.0491*
				(0.0260)	(0.0258)	(0.0263)	(0.0263)	(0.0259)	(0.0259)	(0.0257)	(0.0257)
E) location controls		**Locational variables**									
	w	Mobilité Spatiale regions		y	y	y	y	y	y	y	y
	x	Location Class "ÖV-Güteklasse"		y	Appendix B	y	y	y	y	Appendix B	Appendix B
	y	Population density per hectar		y	Appendix B	y	y	y	y	Appendix B	Appendix B
F) time control		**Time Fixed Effects**									
	z	Year of building application		y	Appendix B	y	y	y	y	Appendix B	Appendix B
G) constant			Constant	7.3174***	7.2658***	7.3123***	7.3115***	7.3166***	7.3156***	7.2690***	7.2689***
			21	-0.0886	(0.1325)	-0.0885	-0.0886	-0.0886	-0.0887	(0.1323)	(0.1324)
H) regression statistics		N		3,562	3,562	3,562	3,562	3,562	3,562	3,562	3,562
		R2		0.5812	0.608	0.5796	0.5798	0.582	0.5821	0.6086	0.6087
		Adjusted R2		0.5649	0.5844	0.5649	0.5649	0.5656	0.5656	0.5849	0.5849
		Residual Std. Error		0.1899 (df = 3428)	0.1856 (df = 3359)	0.1899 (df = 3440)	0.1899 (df = 3439)	0.1898 (df = 3427)	0.1898 (df = 3426)	0.1855 (df = 3358)	0.1855 (df = 3357)
		F Statistic		35.7644*** (df = 133; 3428)	25.7933*** (df = 202; 3359)	39.2029*** (df = 121; 3440)	38.8892*** (df = 122; 3439)	35.6046*** (df = 134; 3427)	35.3450*** (df = 135; 3426)	25.7188*** (df = 203; 3358)	25.5953*** (df = 204; 3357)

Source: Own representation, data from ARE (2020b), Baublatt/Bauinfo-Center Docu Media (2020), FSO (2018), FPRE (2020), MINERGIE (2021).

Note: White heteroskedasticity-consistent (robust) standard errors HC1 are clustered for each location cluster within parenthesis. Significance values 0.10, 0.05, and 0.01 are indicated by *, ** and ***, respectively.

Appendix II/II

Appendix B: Full blown regression results of construction costs/m^2 and net rent/m^2a including amenity controls (specifications [II], [VII], and [VIII]) 1/2

Specifications	(II)	(VII)	(VIII)	(II)	(VII)	(VIII)
A) certificates B) technology controls C) amenity controls D) market & size controls E) location control F) time controls G constant H) regression statistics	[redacted]			[redacted]		

Block	Line	OLS / Specifications / Dependent Variable / Structural Variables	Variable	Construction costs/m2 (II)	Construction costs/m2 (VII)	Construction costs/m2 (VIII)	Net rent/m2a (II)	Net rent/m2a (VII)	Net rent/m2a (VIII)
A) certificates	a	Certificates	MINERGIE Y/N		0.0187** (0.0077)			0.0296** (0.0125)	
		Ref. Cat. = Non-certified buildings							
	b		MINERGIE			0.0157* (0.0081)			0.0254** (0.0129)
	c		MINERGIE-P or higher			0.0496** (0.0241)			0.0637 (0.0454)
B) technology & C) amenity controls	d	Roofing	**MINERGIE standard**	0.0184 (0.0310)	0.0186 (0.0309)	0.0183 (0.0309)	0.0908 (0.1963)	0.0907 (0.1962)	0.0873 (0.1966)
		Reference category = all others							
		Roofing finishes	Green roofing	0.0316*** (0.0058)	0.0313*** (0.0058)	0.0313*** (0.0058)	0.0681*** (0.0081)	0.0678*** (0.0081)	0.0678*** (0.0081)
		Reference category = all others							
	e	Façade	**MINERGIE standard**	0.0090 (0.0365)	0.0095 (0.0364)	0.0102 (0.0364)	-0.0883 (0.0673)	-0.0896 (0.0670)	-0.0916 (0.0670)
		Ref. Cat. = Plastered masonry/ brickwork for Spec. (2), (7) & (8)	Wood	0.0146* (0.0084)	0.0147* (0.0084)	0.0146* (0.0084)	-0.0193 (0.0136)	-0.0197 (0.0136)	-0.0197 (0.0136)
			Metal/steel/light metal	0.0036 (0.0181)	0.0031 (0.0181)	0.0028 (0.0181)	-0.0423 (0.0295)	-0.0435 (0.0294)	-0.0431 (0.0294)
			Natural stone	0.0371 (0.0233)	0.0370 (0.0233)	0.0369 (0.0233)	0.0503 (0.0348)	0.0498 (0.0347)	0.0505 (0.0347)
			Glass	0.0664*** (0.0172)	0.0661*** -0.0172	0.0661*** -0.0172	0.0612** (0.0250)	0.0586** (0.0251)	0.0585** (0.0252)
			Façade elements: concrete/lightweight concrete/artificial stone	0.0264 (0.0219)	0.0258 (0.0219)	0.0262 (0.0219)	0.0108 (0.0421)	0.0108 (0.0420)	0.0112 (0.0421)
			Ventilated curtain façades	0.0263*** (0.0092)	0.0263*** (0.0092)	0.0263*** (0.0092)	0.0163 (0.0142)	0.0162 (0.0141)	0.0158 (0.0142)
			Fiber cement plates	-0.0062 (0.0147)	-0.0062 (0.0147)	-0.0063 (0.0147)	-0.0403* (0.0216)	-0.0400* (0.0216)	-0.0394* (0.0216)
			Ceramic	0.0348 (0.0299)	0.0353 (0.0298)	0.0354 (0.0298)	0.0654* (0.0347)	0.0657* (0.0345)	0.0663* (0.0345)
			Exposed masonry/brickwork	0.0226 (0.0231)	0.0224 (0.0231)	0.0226 (0.0231)	0.0036 (0.0428)	0.0023 (0.0430)	0.0026 (0.0430)
			Sandwich panels	-0.0122 (0.0423)	-0.0121 (0.0422)	-0.0125 (0.0422)	-0.0218 (0.0743)	-0.0228 (0.0746)	-0.0264 (0.0752)
			Exposed concrete	0.0450*** (0.0144)	0.0450*** (0.0144)	0.0452*** (0.0144)	0.0084 (0.0243)	0.0083 (0.0244)	0.0086 (0.0244)
			Compact façades	0.0157 (0.0165)	0.0153 (0.0165)	0.0156 (0.0165)	-0.0181 (0.0243)	-0.0191 (0.0242)	-0.0193 (0.0242)
			Façades without specifications	0.0000 (0.0195)	-0.0003 (0.0195)	-0.0005 (0.0195)	-0.0262 (0.0251)	-0.0268 (0.0251)	-0.0262 (0.0252)
	f	Windows	**Minergie standard**	-0.0685 (0.0438)	-0.0683 (0.0439)	-0.0682 (0.0438)	-0.048 (0.0815)	-0.0457 (0.0811)	-0.0398 (0.0821)
		Ref. Cat. = Plastic windows for Spec. (2), (7) & (8)	Wood windows	0.0536*** (0.0115)	0.0534*** (0.0115)	0.0533*** (0.0115)	0.0034 (0.0191)	0.0041 (0.0191)	0.0043 (0.0191)
			Metal/lightweight metal windows	0.0400*** (0.0126)	0.0404*** (0.0127)	0.0406*** (0.0127)	0.0023 (0.0264)	0.0037 (0.0264)	0.0042 (0.0264)
			Thermal and acoustic insulated windows	0.0708 (0.0878)	0.0727 (0.0873)	0.0724 (0.0874)	0.0848 (0.0598)	0.0845 (0.0594)	0.0835 (0.0594)
			Balcony and terrace windows	0.0112 (0.0197)	0.0104 (0.0196)	0.0107 (0.0196)	-0.0196 (0.0387)	-0.0223 (0.0389)	-0.0215 (0.0388)
			Wood/metal windows	0.0459*** (0.0058)	0.0457*** (0.0058)	0.0457*** (0.0058)	0.0139* (0.008)	0.0135* (0.008)	0.0135* (0.008)
			Windows without specifications	0.005 (0.0170)	0.0051 (0.0170)	0.005 (0.0170)	0.0182 (0.0211)	0.0184 (0.0211)	0.0181 (0.0211)
	g	Heating	**District heating**	0.0489*** (0.0135)	0.0484*** (0.0135)	0.0487*** (0.0135)	0.0038 (0.0213)	0.0021 (0.0214)	0.0017 (0.0214)
	h	Ref. Cat. = Oil-fired heating for Spec. (2), (7) & (8)	**Heat pumps**	0.0281** (0.0120)	0.0278** (0.0120)	0.0280** (0.0120)	0.0193 (0.0191)	0.0182 (0.0191)	0.0179 (0.0191)
	i		**Solar heating systems**	0.006 (0.0071)	0.0061 (0.0071)	0.0061 (0.0071)	-0.0028 (0.0110)	-0.0024 (0.0110)	-0.0026 (0.0110)
	j		**Geothermal energy/ground probes/collectors**	0.0311*** (0.0058)	0.0310*** (0.0058)	0.0310*** (0.0058)	0.0192** (0.0088)	0.0191** (0.0088)	0.0191** (0.0088)
	k		**Wood-fired heating**	0.0279 (0.0189)	0.0283 (0.0189)	0.0285 (0.0189)	-0.0119 (0.0316)	-0.0102 (0.0316)	-0.0106 (0.0316)
	l		**Woodchip heating**	0.0504** (0.0239)	0.0498** (0.0239)	0.0498** (0.0239)	0.0123 (0.0353)	0.0084 (0.0341)	0.0091 (0.0343)
	m		**Pellet heating**	0.0596*** (0.0173)	0.0594*** (0.0173)	0.0597*** (0.0173)	0.0075 (0.0242)	0.0046 (0.0241)	0.0049 (0.0241)
	n		**Controlled room ventilation/comfort ventilation**	0.0180* (0.0099)	0.0171* (0.0099)	0.0175* (0.0099)	0.005 (0.0133)	0.0032 (0.0134)	0.0033 (0.0134)
			Gas-fired heating	0.0206* (0.0125)	0.0207* (0.0125)	0.0209* (0.0125)	0.0258 (0.0192)	0.0252 (0.0192)	0.0249 (0.0192)
			Electric heating	0.0186 (0.0293)	0.0175 (0.0293)	0.0181 (0.0293)	0.0087 (0.1243)	0.0086 (0.1245)	0.009 (0.1243)
			Chimney/Chimney stove	0.0430*** (0.0081)	0.0432*** (0.0080)	0.0432*** (0.0080)	0.0330** (0.0132)	0.0324** (0.0132)	0.0323** (0.0132)
			Floor heating	-0.0043 (0.0084)	-0.0048 (0.0085)	-0.0048 (0.0085)	0.0122 (0.0135)	0.0124 (0.0135)	0.0123 (0.0135)
			Radiators/Flat panel radiators	0.0241 (0.0275)	0.0238 (0.0274)	0.0237 (0.0274)	0.0106 (0.0245)	0.0114 (0.0245)	0.0116 (0.0246)
			Heating without specifications	0.0545*** (0.0152)	0.0539*** (0.0152)	0.0540*** (0.0152)	0.0193 (0.0217)	0.0189 (0.0217)	0.0186 (0.0218)
	o	Insulation	**Minergie standard insulation**	0.0545* (0.0281)	0.0529* (0.0281)	0.0520* (0.0282)	0.034 (0.0826)	0.0329 (0.0817)	0.0319 (0.0817)
		Reference category = all others	Internal thermal insulation	-0.0243** (0.0111)	-0.0244** (0.0111)	-0.0244** (0.0111)	-0.0005 (0.0162)	-0.0001 (0.0162)	0.00004 (0.0162)
			External thermal insulation	-0.0152 (0.0094)	-0.0158* (0.0094)	-0.0158* (0.0094)	-0.0245* (0.0144)	-0.0253* (0.0144)	-0.0251* (0.0144)
			In-between thermal insulation	0.0260** (0.0129)	0.0251* (0.0129)	0.0249* (0.0129)	-0.0285 (0.0214)	-0.0293 (0.0214)	-0.0294 (0.0214)
			Thermal insulation of earth-contacting components	0.0065 (0.0115)	0.006 (0.0115)	0.006 (0.0115)	-0.0296 (0.0205)	-0.029 (0.0205)	-0.0293 (0.0205)
			Insulation and seal without specifications	0.0201 (0.0123)	0.0196 (0.0123)	0.0198 (0.0123)	-0.0169 (0.0196)	-0.0166 (0.0196)	-0.0168 (0.0196)
	p	Electricity	**Solar energy**	0.0247*** (0.0080)	0.0246*** (0.0080)	0.0246*** (0.0080)	-0.0008 (0.0148)	-0.0011 (0.0148)	-0.0009 (0.0148)
		Reference category = all others							
		Supporting Structure	Wood	-0.0138 (0.0107)	-0.0139 (0.0107)	-0.0142 (0.0107)	0.0157 (0.0167)	0.0156 (0.0167)	0.0157 (0.0166)
		Reference category = Concrete	Brick	-0.0019 (0.0071)	-0.002 (0.0072)	-0.0021 (0.0072)	0.0127 (0.0122)	0.0125 (0.0122)	0.0125 (0.0122)
			Aerated concrete blocks	-0.1297*** (0.0379)	-0.1287*** (0.0379)	-0.1296*** (0.0379)	-0.055 (0.0686)	-0.0549 (0.0687)	-0.0537 (0.0685)
			Sand-lime brick	0.0397 (0.0473)	0.0379 (0.0471)	0.0385 (0.0471)	0.0381 (0.0560)	0.04 (0.0562)	0.0399 (0.0561)
			Skeleton consruction (concrete, steel, wood)	-0.0081 (0.0294)	-0.0071 (0.0294)	-0.0074 (0.0294)	-0.0081 (0.0497)	-0.0095 (0.0497)	-0.0085 (0.0497)
			Steel	-0.0329 (0.0206)	-0.0329 (0.0206)	-0.033 (0.0206)	0.0134 (0.0211)	0.0137 (0.0210)	0.0145 (0.0211)
			Double-shell masonry/brickwork	0.0224 (0.0189)	0.0223 (0.0189)	0.0219 (0.0189)	0.0629** (0.0281)	0.0632** (0.0281)	0.0633** (0.0281)
			Exposed masonry/brickwork	0.0244 (0.0421)	0.0248 (0.0424)	0.0251 (0.0424)	0.0125 (0.0684)	0.0012 (0.0795)	0.0037 (0.0782)
			Single-layer masonry/brickwork	-0.0087 (0.0213)	-0.0094 (0.0213)	-0.0094 (0.0214)	-0.0281 (0.0294)	-0.0291 (0.0293)	-0.0288 (0.0293)
			Supporting structure without specifications	0.0088 (0.0152)	0.0088 (0.0152)	0.0088 (0.0152)	0.0549** (0.0244)	0.0539** (0.0243)	0.0537** (0.0243)

25

Appendix B: Full blown regression results of construction costs/m^2 and net rent/m^2a including amenity controls (specifications [II], [VII], and [VIII]) 2/2

Specifications	(II)	(VII)	(VIII)	(II)	(VII)	(VIII)
A) certificates B) technology controls C) amenity controls D) market & size controls E) location control F) time controls G constant H) regression statistics	[redacted]			[redacted]		

Block	Line	OLS / Specifications / Dependent Variable / Structural Variables	Variable	Construction costs/m2 (II)	Construction costs/m2 (VII)	Construction costs/m2 (VIII)	Net rent/m2a (II)	Net rent/m2a (VII)	Net rent/m2a (VIII)
B) technology & C) amenity controls		Flooring	Floor underlay	-0.0305 (0.0737)	-0.0336 (0.0737)	-0.0335 (0.0737)	-0.0106 (0.0598)	-0.0121 (0.0594)	-0.0118 (0.0593)
		Reference category = all others	Artificial stone flooring	-0.0431*** (0.0109)	-0.0430*** (0.0109)	-0.0427*** (0.0109)	-0.0212 (0.0172)	-0.0214 (0.0171)	-0.0214 (0.0171)
			Parquet flooring	-0.0123** (0.0059)	-0.0124** (0.0059)	-0.0124** (0.0059)	-0.0214** (0.0088)	-0.0214** (0.0088)	-0.0213** (0.0088)
			Linoleum flooring/synthetic flooring	0.0355 (0.0255)	0.0353 (0.0255)	0.0348 (0.0254)	0.0217 (0.0434)	0.0224 (0.0429)	0.0204 (0.0426)
			Textile flooring	-0.0404* (0.0244)	-0.0402* (0.0244)	-0.0399 (0.0244)	-0.0053 (0.0429)	-0.0077 (0.0427)	-0.0072 (0.0427)
			Ceramic flooring	-0.0024 (0.0070)	-0.0019 (0.0071)	-0.0019 (0.0071)	-0.0092 (0.0111)	-0.0089 (0.0111)	-0.0089 (0.0111)
			Wooden flooring	-0.0013 (0.0218)	-0.0011 (0.0218)	-0.0017 (0.0218)	-0.0395 (0.0450)	-0.0372 (0.0447)	-0.0373 (0.0448)
			Concrete flooring	-0.0251** (0.0104)	-0.0253** (0.0104)	-0.0253** (0.0104)	0.0060 (0.0146)	0.0062 (0.0147)	0.0064 (0.0147)
			Raised/false flooring	0.0315** (0.0125)	0.0317** (0.0124)	0.0317** (0.0124)	0.0215 (0.0161)	0.0216 (0.0161)	0.0219 (0.0161)
			Natural stone flooring	0.0834*** (0.0199)	0.0832*** (0.0199)	0.0834*** (0.0199)	0.001 (0.0305)	0.0017 (0.0306)	0.0017 (0.0306)
			Laminate flooring	-0.0265 (0.0170)	-0.0261 (0.0169)	-0.0262 (0.0169)	-0.0337 (0.0262)	-0.0323 (0.0263)	-0.0324 (0.0263)
			Industrial jointless flooring	0.0107 (0.0337)	0.0107 (0.0337)	0.0111 (0.0336)	-0.0163 (0.0433)	-0.0147 (0.0432)	-0.0145 (0.0433)
		Interior							
		Not differentiated							
		Equipment	Air conditioner	0.0553 (0.0384)	0.0562 (0.0386)	0.0576 (0.0385)	-0.0137 (0.0386)	-0.0104 (0.0387)	-0.0106 (0.0387)
			Conveyor system	0.0202*** (0.0070)	0.0200*** (0.0070)	0.0200*** (0.0070)	0.0374*** (0.0103)	0.0370*** (0.0103)	0.0371*** (0.0103)
			Sun and weather protection	-0.0313 (0.1047)	-0.0302 (0.1052)	-0.031 (0.1051)	0.0567 (0.0958)	0.0559 (0.0955)	0.0554 (0.0958)
			Building automation	0.0433** (0.0214)	0.0433** (0.0213)	0.0430** (0.0214)	0.0145 (0.0349)	0.0149 (0.0345)	0.0143 (0.0346)
			Safety technology	-0.0193 (0.0192)	-0.0192 (0.0192)	-0.019 (0.0192)	-0.0473 (0.0330)	-0.0472 (0.0326)	-0.0467 (0.0327)
			Garage gate	0.0049 (0.0074)	0.0051 (0.0074)	0.0053 (0.0074)	0.0477*** (0.0108)	0.0478*** (0.0108)	0.0481*** (0.0108)
			Landscaping	-0.0745 (0.0504)	-0.0749 (0.0503)	-0.0752 (0.0503)	-0.0448 (0.0500)	-0.0456 (0.0501)	-0.0464 (0.0502)
			Cooling systems	0.0516*** (0.0108)	0.0517*** (0.0108)	0.0517*** (0.0108)	0.0001 (0.0154)	0.0002 (0.0154)	0.0001 (0.0154)
			Tank installations (areas with heating)	-0.0179 (0.1423)	-0.017 (0.1422)	-0.0163 (0.1422)	0.1442 (0.0893)	0.1454 (0.0906)	0.145 (0.0907)
			Terraces/balconies	0.0254 (0.0335)	0.026 (0.0336)	0.0263 (0.0336)	-0.0187 (0.0466)	-0.0185 (0.0462)	-0.0167 (0.0458)
			Ventilation	0.0211 (0.0144)	0.0213 (0.0144)	0.0213 (0.0144)	-0.0200 (0.0207)	-0.0201 (0.0207)	-0.0200 (0.0207)
			Habitat/pond	0.0445 (0.0731)	0.0447 (0.0731)	0.0452 (0.0733)	-0.1847*** (0.0392)	-0.1849*** (0.0391)	-0.1849*** (0.0391)
			Pergola	0.0212** (0.0087)	0.0211** (0.0087)	0.0211** (0.0087)	-0.0035 (0.0121)	-0.0039 (0.0121)	-0.0039 (0.0121)
			External lighting	0.017 (0.0127)	0.017 (0.0127)	0.0168 (0.0127)	0.0227 (0.0224)	0.0227 (0.0224)	0.0225 (0.0224)
			Irrigation system	0.0226 (0.0935)	0.0254 (0.0938)	0.026 (0.0939)	0.1960*** (0.0614)	0.1954*** (0.0613)	0.1950*** (0.0612)
			Controlled parking system	0.0543 (0.0553)	0.0517 (0.0556)	0.0491 (0.0550)	-0.0647* (0.0365)	-0.0617* (0.0364)	-0.0617* (0.0364)
D) market & size controls	q	Market	Owner-occupied property	0.0356*** (0.0049)	0.0354*** (0.0049)	0.0355*** (0.0049)	-0.0011 (0.0077)	-0.0014 (0.0077)	-0.0015 (0.0077)
	r	Size	ln(Number of apartments)	0.2504*** (0.0098)	0.2504*** (0.0097)	0.2505*** (0.0097)	-0.0306*** (0.0051)	-0.0311*** (0.0051)	-0.0311*** (0.0051)
	s		ln(Square area per project [m2])	-0.3506*** (0.0103)	-0.3508*** (0.0103)	-0.3509*** (0.0102)			
	t		ln(Storeys)	0.0232** (0.0096)	0.0231** (0.0096)	0.0229** (0.0096)	0.008 (0.0139)	0.0078 (0.0139)	0.0077 (0.0139)
	u		ln(Mean net floor area)				-0.3484*** (0.0228)	-0.3483*** (0.0228)	-0.3481*** (0.0228)
	v		ln(Mean number of rooms)				0.0498* (0.0258)	0.0491* (0.0257)	0.0491* (0.0257)
E) location		**Locational variables**							
	w	Mobilité Spatiale regions		y	y	y	y	y	y
	x	Accessibility by public transport Reference category = none	A	0.0249** (0.0115)	0.0254** (0.0115)	0.0258** (0.0115)	0.0846*** (0.0163)	0.0846*** (0.0164)	0.0848*** (0.0164)
			B	0.0161* (0.0088)	0.0168* (0.0088)	0.0169* (0.0088)	0.0613*** (0.0133)	0.0611*** (0.0133)	0.0611*** (0.0133)
			C	0.0011 (0.0072)	0.0018 (0.0072)	0.0019 (0.0072)	0.0422*** (0.0118)	0.0421*** (0.0118)	0.0422*** (0.0118)
			D	0.0032 (0.0061)	0.0038 (0.0061)	0.0037 (0.0061)	0.0188 (0.0116)	0.0185 (0.0116)	0.0184 (0.0116)
	y	Population density per hectar		-0.0060** (0.0023)	-0.0059** (0.0023)	-0.0059** (0.0023)	-0.0133*** (0.0035)	-0.0131*** (0.0035)	-0.0131*** (0.0035)
F) time		**Time Fixed Effects**							
	z	Year of building application Reference category = 2010	2011	0.0415*** (0.0103)	0.0418*** (0.0103)	0.0418*** (0.0103)	0.0166 (0.0145)	0.0159 (0.0145)	0.0161 (0.0145)
			2012	0.0841*** (0.0104)	0.0843*** (0.0104)	0.0843*** (0.0104)	0.0222 (0.0146)	0.0216 (0.0146)	0.0219 (0.0146)
			2013	0.0882*** (0.0101)	0.0889*** (0.0101)	0.0889*** (0.0101)	0.015 (0.0138)	0.0157 (0.0138)	0.0159 (0.0138)
			2014	0.0901*** (0.0104)	0.0906*** (0.0104)	0.0906*** (0.0104)	0.0093 (0.0139)	0.0098 (0.0139)	0.01 (0.0139)
			2015	0.0967*** (0.0104)	0.0972*** (0.0104)	0.0974*** (0.0104)	0.0128 (0.0139)	0.0129 (0.0139)	0.0131 (0.0139)
			2016	0.1113*** (0.0107)	0.1121*** (0.0107)	0.1122*** (0.0107)	0.0013 (0.0136)	0.002 (0.0136)	0.0021 (0.0136)
			2017	0.1057*** (0.0106)	0.1066*** (0.0107)	0.1066*** (0.0107)	0.0081 (0.0152)	0.0087 (0.0152)	0.0084 (0.0152)
			2018	0.0986*** (0.0106)	0.0999*** (0.0106)	0.0999*** (0.0106)	-0.0196 (0.0172)	-0.0183 (0.0172)	-0.0183 (0.0172)
			2019	0.1320*** (0.0118)	0.1335*** (0.0118)	0.1334*** (0.0118)	-0.0758*** (0.0203)	-0.0744*** (0.0203)	-0.0743*** (0.0203)
			2020	0.1255*** (0.0135)	0.1269*** (0.0135)	0.1267*** (0.0135)	-0.2356*** (0.0326)	-0.2339*** (0.0326)	-0.2349*** (0.0326)
G) constant			Constant	9.6325*** (0.1323)	9.6331*** (0.1324)	9.6344*** (0.1324)	7.2658*** (0.1325)	7.2690*** (0.1323)	7.2689*** (0.1324)
H) regression statistics		N		11,993	11,993	11,993	3,562	3,562	3,562
		R2		0.321	0.3214	0.3215	0.608	0.6086	0.6087
		Adjusted R2		0.3092	0.3095	0.3095	0.5844	0.5849	0.5849
		Residual Std. Error		0.2378 (df = 11786)	0.2377 (df = 11785)	0.2377 (df = 11784)	0.1856 (df = 3359)	0.1855 (df = 3358)	0.1855 (df = 3357)
		F Statistic		27.0538*** (df = 206; 11786)	26.9608*** (df = 207; 11785)	26.8409*** (df = 208; 11784)	25.7933*** (df = 202; 3359)	25.7188*** (df = 203; 3358)	25.5953*** (df = 204; 3357)

26

Source: Own representation, data from ARE (2020b), Baublatt/Bauinfo-Center Docu Media (2020), FSO (2018), FPRE (2020), MINERGIE (2021).

Note: White heteroskedasticity-consistent (robust) standard errors HC1 are clustered for each location cluster within parenthesis. Significance values 0.10, 0.05, and 0.01 are indicated by *, ** and ***, respectively.