The Impact of Energy Labels and Accessibility on Office Rents

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Abstract

Energy consumption in the commercial property sector offers an important opportunity for conserving resources. In this study, we evaluate the financial implications of two elements of "sustainability" – energy efficiency and accessibility – in the market for commercial real estate. An empirical analysis of some 1,100 leasing transactions in the Netherlands over the 2005-2010 period shows that buildings designated as inefficient (with an EU energy performance certificate D or worse) command rental levels that are some 6.5 percent lower as compared to energy efficient, but otherwise similar buildings (labeled A, B or C). Furthermore, this study shows that office buildings in multi-functional areas, with access to public transport and facilities, achieve rental premiums over mono-functional office districts. For policymakers, the results documented in this paper provide an indication on the effectiveness of the EU energy performance certificate as a market signal in the commercial property sector. The findings documented here are also relevant for investors in European office markets, as the importance of energy efficiency and locational diversification is bound to increase following stricter environmental regulation and changing tenant preferences.

JEL codes: G51, M14, D92

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1. Introduction

Energy efficiency in the built environment can play an important role in the reduction of global carbon emissions (Stern, 2008). This has been recognized by the introduction of the Energy Performance of Buildings Directive (EPBD) in January 2003, leading to the implementation of energy performance certificates for residential and commercial buildings across the European Union (see Andaloro et al., 2010, for a comparative analysis of progress towards implementation of the EPBD).

Even though the global financial crisis and subsequent downturn in commercial property markets have not dented the ever-increasing interest in the "sustainability" of the built environment, the impact of energy efficiency and sustainability on real estate investment performance remains a heavily debated subject, and many (institutional) investors are reluctant to invest in energy efficiency measures and retrofitting of existing properties. Of course, financing and liquidity constraints play a role, especially given current macroeconomic conditions, but the lack of evidence on the returns to energy efficiency improvements continues to be one of the most important barriers to energy efficiency investments.

Part of the return to energy efficiency improvements consists of relatively predictable energy savings, but under standard lease contracts and in multi-tenant buildings, these typically flow to the occupants. For investors, the return is thus uncertain, consisting of better marketability of properties (e.g., lower vacancy risks, higher rents while keeping total housing costs fixed, shorter rent-free periods) and higher valuations (following lower cap rates and reduced depreciation). The implementation of energy performance certificates can be regarded as an additional step towards transparency of energy consumption in buildings, enabling private and corporate occupiers to take energy efficiency into account when making housing decisions. Indeed, recent evidence shows that the EU energy label is effective as a signaling device in the residential housing market (Brounen and Kok, 2011).

When it comes to commercial real estate, evidence on the adoption and evaluation of energy labels is scant. Existing "green" labels, such as BREEAM in the UK and the US Green Building Council's LEED, offer the opportunity to assess the financial impact of "sustainability" on real estate assets, but most research is U.S.-based. Studies of the European property market have thus far been hindered by the slow diffusion of heterogeneous labeling schemes and a lack of centralized transaction data.

This paper is the first to offer systematic insight in the effects of the main components of sustainability – energy efficiency and accessibility – on realized rents in the European office market, using the Netherlands as a case study. We create a unique dataset, combining the databases of the three largest real estate agents in the Netherlands, CBRE, DTZ Zadelhoff and Jones Lang LaSalle, thereby overcoming the problem of lack of centralization in data gathering. The real estate transaction data are combined with the database of energy performance certificates (EPCs) for buildings, maintained by the Dutch Ministry of Economic Affairs. EPCs are based on energy performance assessments and mandatory for every real estate transaction. Labels vary from G, for inefficient properties, to A++ for highly efficient buildings.

Based on an empirical analysis, correcting for the most important value drivers in real estate – location, age and size of office properties – we document for a sample of some 1,100 rental transactions in the Netherlands that properties designated as less efficient (with energy labels D or lower) yield significantly lower rents. We also find that the rental growth of energy-efficient offices deviates strongly from rental growth of inefficient offices, a development starting in 2009. Furthermore, the analysis shows that both the distance to train stations and the "walkability" of offices (i.e., the location of an office relative to facilities such as restaurants and shops) have an important impact on rental prices in the office market.

The results documented in this research provide the first credible evidence that "sustainability" (or: energy efficiency and accessibility) matters for corporate tenants in the European real estate market, corroborating with existing evidence on the U.S. office market (Eichholtz et al., 2010) and the Dutch residential market (Brounen and Kok, 2011). These findings have implications for the portfolios of real estate investors: energy efficiency affects rental levels and rental growth. Accessibility is priced as well. Both components of sustainability have an impact on the value of "green" as well as "non-green" commercial properties. For policymakers, the results documented in this paper provide an indication on the effectiveness of the EU energy performance certificate as a market signal in the commercial property sector.

The remainder of this paper is organized as follows: Section 2 provides some background on the literature examining the financial implications of "sustainability" in buildings. Section 3 discusses the EU energy performance certificate and its diffusion in the Dutch office market. Section 4 describes the financial data and presents the analysis, relating the "sustainability" of a large sample of office buildings to realized rents. Section 5 is a brief conclusion and provides some implications for policy makers.

2. Background Literature

The influence of sustainability and energy efficiency on the financial performance of commercial property investments is mostly a topic of speculation, rather than being subject to rigorous empirical evaluation. One can make a distinction between the direct implications of investments in the energy performance of buildings and the indirect effect that energy efficiency may have on building rents and prices. The expected return from investments in building energy efficiency, following from cost savings, is often thought off as clear-cut: it is claimed that the real estate sector represents the largest opportunity to reduce carbon emissions at attractive returns (Enkvist et al., 2007). It is also assumed that building improvements are generally NPV positive, with varying discount rates for different types of consumers (Jaffe and Stavins, 1994). The question remains why private investments in building energy efficiency have thus far not taken off at a larger scale (this is also know as the "energy efficiency paradox," see Kok et al., 2011, for a discussion).

Recent micro-economic studies investigating the return on building retrofit investments are mostly focused on the U.S. "ESCO" market – Energy Service Companies (ESCOs) are specialized in the development, installation, financing and maintenance of energy efficiency investments in real estate. The costs of the various services are bundled and paid out of the energy savings, with the actual units of energy saved often guaranteed by the ESCO. Studies of the Lawrence Berkeley National Lab show energy savings of about 15-20 percent, with payback periods varying between five and fifteen years (depending on the implemented technology, see Goldman et al., 2005, for a discussion). However, the ESCO market is mostly focused on semi-public real estate (e.g., schools, universities, and hospitals), which has the advantage of being owner-occupied, thereby reducing concerns about the split-incentive between tenants and building owners in the reduction of energy consumption. Furthermore, academic evidence on the risk-return characteristics of ESCO-investments in the energy efficiency of commercial real estate is limited.

The literature on the implications of energy efficiency investments for building owners is more developed, even though most studies focus on the U.S. commercial property market. Recent research documents a positive effect of sustainability and/or energy efficiency labels on rents and prices of office properties: this holds pre-crisis (Eichholtz et al., 2010; Fuerst and McAllister, 2011) as well as during the financial crisis (Eichholtz et al., in press). An important finding is the quite precise relation between the extent of energy efficiency and rents and prices: tenants pay about 95 cents for a dollar in energy savings and investors capitalize lower energy costs with a discount rate of eight percent (just slightly higher as compared to current cap rates in some U.S. office markets).

The market capitalization of energy efficiency and sustainability in Europe has been assessed empirically for the residential market. A recent study by Brounen and Kok (2011) evaluates the dissemination and market valuation of EU energy labels (EPCs) in the Dutch housing market and finds that, even though the adoption rate of energy labels is low, the relative energy efficiency of private dwellings has a significant impact on selling prices.

Market evidence on willingness to pay for "green" real estate in the European commercial property market is mostly anecdotal: Jones Lang LaSalle and CoreNet Global frequently survey corporate tenants and investors regarding their desire for more sustainable office space. According the March 2010 survey "…83 percent [of the tenants] is willing to pay a rental premium, if this is reflected in tangible benefits" (JLL, 2010). The willingness to pay for "green" is partly determined by social factors but of course also by the cost reduction potential.

In order to reduce total housing costs, i.e., the combined cost of rent and service and energy charges, the tenant will, ceteris paribus, prefer energy efficient buildings over non-efficient alternatives as the tenant directly or indirectly pays for energy usage. However, it has been argued that the structure of lease contracts may influence energy-saving behavior. The CBRE Global Office Occupier Guide shows that in the United States there are three ways in which the tenant generally pays for electricity usage. In some, mostly single-tenant buildings, a meter is installed and the tenant pays directly to the utility company. A second possibility is that the landlord pays the utility company, but that the tenant then compensates the landlord based on actual usage measured by a submeter. A third option is that electricity expenses are included in the service charges on a price per square foot basis. Some electricity-intensive tenants, e.g., data centers, would pay an additional amount to cover the above-average usage of electricity. The last type of energy expense billing may induce moral hazard issues in multi-tenant buildings, as additional usage is spread over several tenants.

On the European continent the options for energy cost charges are similar to the United States and the nature of compensating the landlord for energy costs does not differ substantially across countries. In France, Germany, Spain and the United Kingdom it is most common that the tenant signs a contract with an electricity supplier directly for the floorspace occupied by the tenant and pays for water and electricity charges for common areas through the service charges. In the Netherlands, it is more common that energy and water costs are covered in the service charges per square meter with annual settlement based on actual usage by all tenants combined at the end of the year. If available the tenant pays for actual usage based on a meter. A sign of technological advances and more energy usage awareness is that newer buildings in a warm country like Spain are equipped with air-conditioning equipment separately for each tenant, whereas cooling charges in older buildings are still based on per square meter service charges. Technological advances and an increase in individual metering will limit moral hazard issues and allow energy conscious tenants to reduce total housing costs by active monitoring heating and cooling settings.

Of course, in market equilibrium, all types of rental contracts will ultimately lead to similar total housing costs, despite differences in the way that energy costs are paid. Tenants focusing on total housing costs will thus favor energy efficient buildings over similar non-efficient buildings, but the question remains how survey-based evidence on willingness to pay for energy efficiency translates into occupancy rates, rents and prices of commercial real estate in practice. Recent evidence of DTZ Zadelhoff documents that, based on appraisals of 150 offices in the Netherlands, energy labels are positively correlated with building value (DTZ Zadelhoff, 2011). A similar study of Troostwijk Real Estate, a consultancy, compares rents and prices of office properties with "green" labels and "non-green" labels and also documents a positive relation between energy efficiency and values (Troostwijk Real Estate, 2011). The results of both studies show substantial differences in rental levels and discount rates between efficient and inefficient office buildings. We note, however, that these studies do not fully account for crucial determinants of commercial building value, such as location and year of construction. Omitting these factors potentially affects the results: energy efficient buildings are often recently constructed, which affects their marketability.

3. The EU Energy Performance Certificate (EPC)

The European Union implemented the Energy Performance of Buildings Directive (EPBD) in January 2003 with the explicit goal of promoting energy performance improvements in buildings. The Directive, which was recently recast, includes an explicit element on the disclosure of energy performance in buildings: "…Member states shall ensure that, when buildings are constructed, sold or rented out, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant (Article 7, Energy Performance of Buildings Directive, EU, 2009)." The Directive has lead to the implementation of national energy performance certificates (EPCs) for residential dwellings as well as utility buildings (e.g., office, retail, schools, and healthcare facilities) across the European Union. Despite the intentions of a swift and uniform introduction of EPCs across Europe it is apparent that not all member states have implemented similar policies. Andalaro et al.

(2010) examined the uniformity and excellence of the EPBD across Europe and found that there are still large variations across Europe, and most countries are just halfway towards achieving "excellence."

Agentschap NL, an agency of the Dutch Ministry of Economic Affairs, exerts quality control and maintains registration of the energy performance certificates in the Netherlands. For the purpose of this study we were granted access to the database of this government agency, which provides information on the energy performance rating, the address, and some physical building characteristics of all commercial buildings with an energy performance certificate. As of December 2011, more than 10,500 buildings (including retail, office, sports facilities, schools, etc.) had been certified. The total square footage of these buildings represents some 30 million square meters, with offices accounting for some 68 percent (20.6 million square meter). The energy label database covers about 44 percent of the total Dutch office market (estimated at 47 million square meter).

Information available for each property includes address, year of construction, year of renovation, surface area and energy characteristics (i.e., energy index and energy label).

A. Energy Performance Certificates: Age and Size

Figure 1A shows the composition of energy labels for different construction periods. Mainly due to the fast growth in office space during the 1991 – 2000 period, this era has the highest representation in the database. Quite clearly, technological developments and increasingly strict building codes have lead to more efficient construction over the past decades. The number of least efficient office buildings (energy label G) is largest in the category "Constructed before 1940." The absolute number of G-labeled properties remains relatively constant until 1990, but the share of inefficient office buildings decreases due to the rise of newly constructed offices. Even though A-labeled buildings represent about 50 percent of all construction during the 2001 – 2010 period, Figure 1A once again reinforces the challenge facing society -- dealing with the heritage of the past. The existing building stock consists mostly of inefficient, "non-green" buildings. This phenomenon not only holds for very old, historic office properties (pre-1940), but for all buildings constructed until the 1980s. The improvement of energy efficiency partially coincides with the implementation of energy efficiency requirements, which first became active in 1996. A similar relation between vintage and energy consumption has been documented for the residential housing market. Brounen et al. (in press) document that dwellings constructed before 1980 are at least 50 percent less efficient as compared to dwellings constructed after 2000.

Figure 1A.
Label Composition Per Construction Period (Number of Buildings)

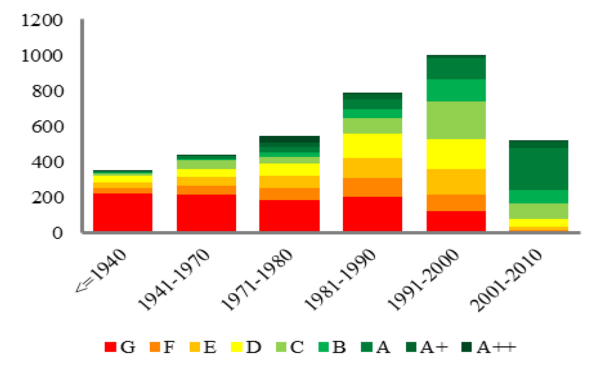


Figure 1B.
Average Building Size (m^2)

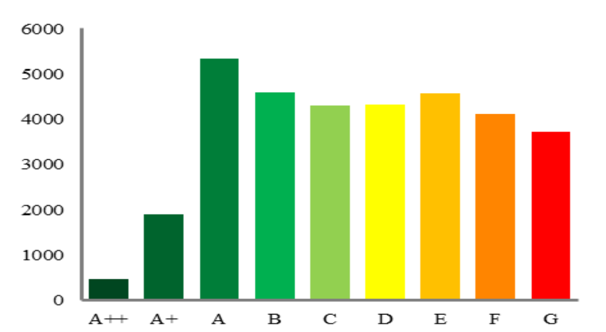


Figure 1B shows the relation between surface area (i.e., building size) and the energy performance certificate. With the exception of A+ and A++, the average size of properties with labels A through G is quite similar. Buildings with label A are largest, on average, and buildings with label G are smallest, on average. However, differences are quite small, which may indicate that a minimum building size is not a prerequisite for engaging in energy efficiency investments. This contrasts the oft-invoked thesis on "economies of scale" in building retrofits (Kok et al., 2011).

The most efficient office properties in our sample (A+ and A++) are very small: the size of these buildings is 450 sq.m. and 1900 sq.m., on average, which is significantly smaller than office properties with an A-label (with an average size of 5000 sq.m.). (We note that the number of observations rated A+ or A++ is quite limited.

B. Green Public Procurement

Green public procurement has now been implemented by most European member states. This implies that national governments choose for a "sustainable" alternative when making purchasing decisions (this includes everything ranging from office supplies to office buildings). The Dutch government started their green procurement program in January 2010. The program has major implications for the real estate market: the national General Services Administration (the government institution responsible for providing office space for government employees) just considers buildings with energy label C or higher for new leases (alternatively, the landlord can improve the energy label of the property by at least two steps). From an environmental perspective, the policy seems to be effective: a recent research report documents that, as a result of the green procurement criteria, office buildings used by the Dutch government will reduce carbon emissions by about 16 percent in 2020 (as compared to 2010 levels). This explicit demand-shock, created by the largest tenant of office space in the Dutch market, may give an impulse to improving the energy efficiency of the existing office stock in the Netherlands. However, the green procurement policy may also have financial implications for the owners of office properties that do not live up to the leasing criteria of the government.

Figure 2.
Green Public Procurement in the Office Market
(Fraction of Total m^2 Per Province)

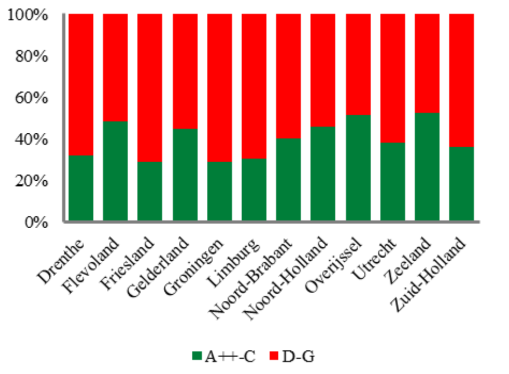


Figure 2 analyses the fraction of the office market in each of the twelve provinces in the Netherlands that does not meet the green procurement criteria (red bar). In each province, the share constitutes at least half of the building stock. Owners of less energy efficient office space will be directly affected, and corporate tenants following the example set by the public authority may reinforce this trend.

4. The Financial Implications of Energy Efficiency

A. Data

Transaction data of commercial real estate are notoriously difficult to obtain in most countries. Lacking consistent data like for instance those provided by the CoStar Group (which covers about 80 percent of all transaction in the U.S. and has reasonable coverage in the U.K.), we combine the proprietary transaction databases of the largest real estate agents in the Netherlands: CBRE, DTZ Zadelhoff and Jones

Lang LaSalle. For each transaction, we collect information on the realized rental price per square meter, the transaction size, the type of lease (new lease, sublease or lease extension), the transaction date, and building characteristics (including size and age).

Using building address, we merge the transaction databases with information on the energy characteristics of the building (i.e., energy performance certificate, modeled energy consumption and the energy index), as collected by the Ministry of Economic Affairs. This results in a unique dataset of 1,072 rental transactions during the 2005 – 2010 period.

Besides energy efficiency, the "sustainability" of an office building is also, and to a large extent, determined by its location relative to public transport and amenities. (Of course, "location, location, location" is also the most important determinant of rental prices.) We use the longitude and latitude of each transaction and calculate the crow fly distance to the nearest highway entrance and exit, and to the nearest railway station. Obviously, the type of railway station (central station versus peripheral station) makes a substantial difference in accessibility. To approximate the service quality of railway stations, we use the "Rail Service Quality Index" (RSQI), which takes into account the number of routes, frequency and number of stops (see Debrezion et al., 2009).

To map the location of a property relative to amenities in the direct vicinity, such as restaurants and retail facilities, we use the "Walk Score." The Walk Score algorithm is based on the crow fly distance of a given address to a varied set of neighborhood amenities. Certain categories receive a higher weight, and scores are distance weighted (see htttp://www.walkscore.com/ for more information about the "Walk Score," underlying parameters, and algorithms). The rationale for including "Walk Scores" is embedded in the urbanization of economies. Clustering of services in a confined area is often found to increase the efficiency of labor and, ceteris paribus, increases the rents that companies can afford to pay (see Melo et al., 2009, for an extensive review on urban agglomeration economies).

The economic impact of the Walk Score on real estate values has been studied previously by Pivo and Fisher (2011). The authors document that the "walkability" of locations is value enhancing for office, retail and industrial properties in the U.S.

B. Descriptive Statistics

Table 1 provides descriptive statistics for the dataset of 1,072 rental transactions, separately for energy efficient ("green") buildings with energy performance certificates A, B or C, and for less efficient ("non-green") buildings with energy performance certificates D, E, F or G.

Table 1
Descriptive Statistics

Panel A: Buildings Labeled A - C					
	Average	Median	St. Dev.	Maximum	Minimum
Rent (€ per m^2)	166.25	160	45.43	350	48
Size of transaction (m^2)	1785.54	950	2351.14	20000	60
Property size (m^2)	10118.19	5710	9497.19	37904	123
Energy Efficiency Index	1.1	1.15	0.16	1.3	0.49
Distance to train station (meter)	1178.71	755	1153.19	4700	66
Station Score (RSQI)	1.56	1.4	0.72	3.47	0.29
Distance to highway junction (meter)	1261.1	870	1119.61	7749	158
Google Walk Score	61.59	62	12.29	88	22
Sublet (percent)	1.93	0	13.77	100	0
Lease extension (percent)	1.65	0	12.77	100	0
Age (years)	13.68	10	12.27	96	1
Panel B: Buildings Labeled D - G					
	Average	Median	St. Dev.	Maximum	Minimum
Rent (€ per m^2)	152.28	146	39.23	360	14.63
Size of transaction (m^2)	1473.86	925	1757.36	27047	60
Property size (m^2)	7293.84	4852.07	7035.13	37053	121.37
Energy Efficiency Index	1.75	1.62	0.36	3.05	1.31
Distance to train station (meter)	1327.88	936	1552.78	15561	36
Station Score (RSQI)	1.65	1.46	0.74	3.47	0.25
Distance to highway junction (meter	1554.53	1281	1601.23	1603.9	102
Google Walk Score	62.53	63	13.67	98	7
Sublet (percent)	1.27	0	11.20	100	0
Lease extension (percent)	2.96	0	16.97	100	0
Renovated (percent)	24.68	0	43.15	100	0
Age (years)	27.77	22	20.56	160	5

The parameter of interest, the realized rent per square meter, is €152, on average for offices with label D or lower. This compares to an average rent of €166 for office properties with label C or higher. Note that this simple (though convenient) comparison does not control for other important quality differences between the two samples: energy-efficient offices are 14 years old, on average, whereas the average "energy hog" is twice as old, on average. Furthermore, the former are substantially larger and closer to public transport and highways.

Figure 3A
The Energy Index and Rental Prices
(1,076 Observations, 2005 - 2010)

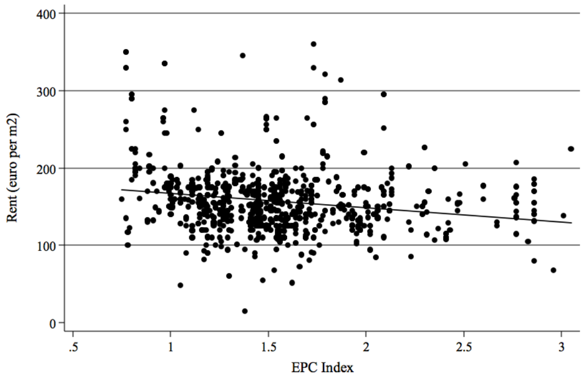
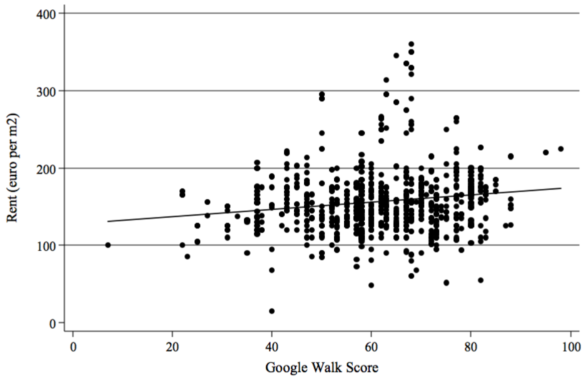


Figure 3B.
The Google Walk Score and Rental Prices
(1,076 Observations, 2005 - 2010)



Figures 3A and 3B illustrate the simple correlation between the energy index and rents and the Walk Score and rents, respectively. Clearly, there is a negative relation between (modeled) energy consumption and the realized rents in Dutch offices.

Lower energy efficiency implies a lower rent. (But of course, this relation is not necessarily causal.) Besides energy efficiency, the accessibility of facilities in the direct vicinity of a property has a direct impact on rents as well: a higher Walk Score is correlated with higher realized rents.

C. Analysis and Results

In line with Eichholtz, et al. (2010, in press) and Brounen and Kok (2011) we analyze the effect of energy efficiency, approximated by energy performance certificates, using the following hedonic specification:

$$(1) \quad \log R_i = \alpha + \beta_i X_i + \sum_{Z}^{z=1} \delta_z z_z + \gamma_i L_i + \rho G_i + \varepsilon_i$$

where the dependent variable is the natural logarithm of the realized rental price per square meter in building *i* (the logarithmic transformation facilitates an easy interpretation of the coefficients). X_i is a vector of quality characteristics, such as age and size of a building. It has been shown that locational density is an important determinant of commercial office rents in the Netherlands (Jennen and Brounen, 2009). To control for density (a proxy for the well-known adage "location, location, …") we include z_z, a binary variable that is unique for each four-digit ZIP code. These ZIP code fixed-effects control very precisely for location-specific determinants of office rents, including (but not limited to) density. In addition, we include L_i, a vector of location characteristics, such as the distance to railway stations and the Walk Score. G_i is a binary variable with a value of one if an office building has an energy performance certificate of D or lower (i.e., an inefficient, "non-green" building), and zero otherwise. In alternative specifications, we use the specific label category (with label D as the reference group), or the energy index.

Table 2 provides the results of the regression analysis as represented by Model (1), focusing on the control variables and the financial implications of accessibility. The explanatory power of the model (Adj. R^2) is quite strong: about two-third of the variation in rental prices in the Dutch office market can be explained with a rudimentary set of building characteristics and location controls.

In line with expectations, we document in Column (1) that older office buildings realize lower rents, as compared to younger buildings of comparable size and at similar locations.

Table 2
The Value of Location
(Dependent Variable: Logarithm of Rent per Square Meter)

	(1)	(2)	(3)	(4)
Age (years)	-0.001**	-0.001**	-0.001**	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]
Renovated (1 = yes)	-0.010	-0.012	-0.013	-0.013
	[0.019]	[0.019]	[0.019]	[0.019]
Distance to highway junction (km)		0.026	-0.042	-0.041
		[0.027]	[0.029]	[0.029]
Distance to train station (km)			-0.132***	-0.134***
			[0.031]	[0.031]
Station Score (RSQI)				-0.015
				[0.039]
Google Walk Score				0.004***
				[0.001]
Size of transaction (m^2, log)	0.006	0.006	0.005	0.005
	[0.008]	[0.008]	[0.008]	[0.008]
Property size (m^2, log)	0.042***	0.043***	0.035***	0.035***
	[0.010]	[0.011]	[0.010]	[0.010]
Sublet (1 = yes)	-0.037	-0.039	-0.047	-0.046
	[0.045]	[0.045]	[0.044]	[0.044]
Lease extension (1 = yes)	0.014	0.014	0.025	0.026
	[0.035]	[0.035]	[0.035]	[0.035]
Constant	4.771***	4.531***	5.157***	5.091***
	[0.171]	[0.178]	[0.260]	[0.256]
Broker dummy?	Yes	Yes	Yes	Yes
Time dummy?	Yes	Yes	Yes	Yes
Location dummy?	Yes	Yes	Yes	Yes
Observations	1071	1071	1057	1057
R^2	0.714	0.714	0.720	0.720
Adj. R^2	0.645	0.645	0.653	0.653

Standard errors are in brackets. Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***, respectively.

However, this effect of building vintage on rents is quite weak: a decade of decay results in rents that are just one percent lower, on average. In alternative specifications, we control for the effect of building vintage using “year of renovation” (rather than “year of construction” in combination with a “renovation” dummy). The results are comparable to those reported here and available from the authors upon request. Furthermore, leasing a square meter is more expensive in larger buildings, ceteris paribus: an increase in building size of one percent leads to an increase of about four percent in rent per square meter.

Accessibility, as measured by the distance to the nearest highway entrance or exit, does not have a significant influence on realized rents (Column 2). However, we document that distance to the nearest railway station matters for tenants (and thus for investors), with higher rents for buildings located closer to public transport. These results hold while controlling for location using four-digit ZIP code areas and corroborate with earlier findings for the Amsterdam office market, in a study on the effect of clustering on office rents (Jennen and Brounen, 2009). For every kilometer increase in distance to the nearest railway station, rents decrease with about 13 percent. Accessibility of public transport matters more than accessibility by car in traffic-clogged Holland.

The application of the Walk Score to approximate density in a real estate pricing framework is relatively new in the literature. The results show that the presence of amenities in the direct neighborhood of an office building is positively and significantly related to rents. This finding is in line with recent evidence for the U.S. and important for real estate investors. There is currently much talk about new work formats, which changes the traditional mono-functional use of an office building in order to facilitate flexible working hours and flexible office space. An attractive neighborhood and multifunctional locations are important for “the office of the future,” and our analysis shows that tenants are already paying higher rents for locations with a more extensive set of facilities in the direct vicinity.

Table 3
The Value of Energy Efficiency
(Dependent Variable: Logarithm of Rent per Square Meter)

	(1)	(2)	(3)	(4)
Energy Efficiency Index	-0.047**			
	[0.022]			
"Non-green" label (D or lower)		-0.065***	-0.075***	
		[0.016]	[0.018]	
"Non-green" label *Amsterdam			-0.032	
			[0.030]	
Label Category				
A				0.042
				[0.030]
B				0.054*
				[0.032]
C				0.097***
				[0.026]
E				-0.008
				[0.029]
F				-0.005
				[0.029]
G				0.023
				[0.025]
Size of transaction (m^2, log)	0.005	0.005	0.006	0.005
	[0.008]	[0.008]	[0.008]	[0.008]
Age (years)	-0.001	-0.000	-0.000	-0.000
	[0.001]	[0.001]	[0.001]	[0.001]
Renovated (1 = yes)	-0.014	-0.019	-0.018	-0.012
	[0.019]	[0.019]	[0.019]	[0.020]
Distance to train station (km)	-0.132***	-0.136***	-0.135***	-0.139***
	[0.031]	[0.031]	[0.031]	[0.031]
Station Score (RSQI)	-0.018	-0.027	-0.031	-0.033
	[0.039]	[0.039]	[0.039]	[0.040]
Distance to highway junction (km)	-0.046	-0.046	-0.047	-0.048
	[0.029]	[0.029]	[0.029]	[0.030]
Google Walk Score	0.004***	0.004***	0.004***	0.003***
	[0.001]	[0.001]	[0.001]	[0.001]
Property size (m^2, log)	0.033***	0.032***	0.031***	0.029***
	[0.010]	[0.010]	[0.010]	[0.010]
Sublet (1 = yes)	-0.052	-0.056	-0.060	-0.060
	[0.044]	[0.044]	[0.044]	[0.044]
Lease extension (1 = yes)	0.030	0.031	0.030	0.028
	[0.035]	[0.035]	[0.035]	[0.035]
Constant	5.194***	5.096***	5.096***	5.170***
	[0.260]	[0.254]	[0.254]	[0.259]
Broker dummy?	Yes	Yes	Yes	Yes
Time dummy?	Yes	Yes	Yes	Yes
Location dummy?	Yes	Yes	Yes	Yes
Observations	1057	1057	1057	1057
R^2	0.722	0.726	0.726	0.727
Adj. R^2	0.654	0.659	0.660	0.660

Standard errors are in brackets. Significance at the 0.10, 0.05, and 0.01 levels are indicated by *, **, and ***, respectively.

The coefficients for the remainder of the control variables are in line with expectations: compared to new leases, subleases yield lower rents and lease extensions yield higher rents, on average (although the effects are not statistically significant).

Table 3 extends the analysis with variables that reflect the energy characteristics of the office properties in our sample. Controlling for year of construction (negative effect on rents), building size (positive effect) and location (four-digit ZIP code), the results in Column (1) show that the energy index is negatively related to rental prices. A one-point increase in the energy index results in a rental decrease of about five percent. The rental difference between the most efficient building in our sample (energy index of 0.49) and the least efficient building (energy index of 3.05) is more than 12 percent.

In Column (2), we address the effect of energy efficiency on rental prices in the Dutch office market. The analysis indicates that office properties labeled as "inefficient," "non-green" labels (D and lower) have realized rents that are some 6 percent lower than rents in comparable offices with labels reflecting higher levels of energy efficiency. This provides the first evidence on the negative effect of higher energy consumption on rental levels in commercial office space, even when controlling rigorously for the most important determinants of rents (location, size and vintage).

In Column (3), we add an "Amsterdam-effect". The office market of Amsterdam, like Frankfurt, London and Paris, is quite distinct from the remainder of the national property market and it may well be that the importance of energy efficiency is affected in these major hotspots with international allure. (For example, the tenant mix and investor demand for office space may be different in these markets.)

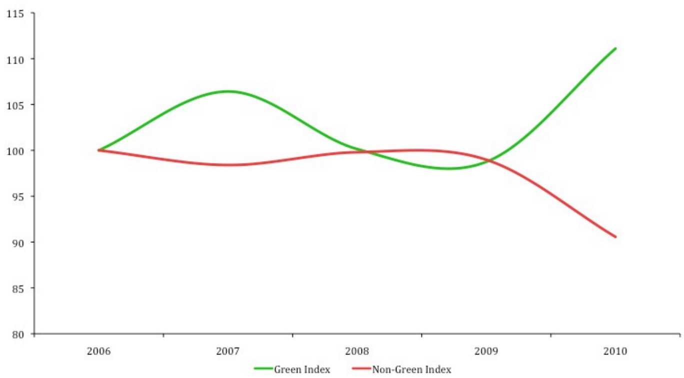
However, we do not find significant evidence that a "green" energy label is less valuable in Amsterdam as compared to the remainder of the country.

We also include the individual label categories, rather than just the "non-green" variable. Column (4) shows that the difference between labels A – C and labels D – G is not just driven by the most efficient buildings: on the contrary, buildings with labels B and C achieve a rental premium over less efficient office buildings in the neighborhood. Offices with energy performance certificate A realize a higher rental rate, but this effect is not significant. These results can be explained in several ways: first, our results quite possibly reflect a "crisis effect": the high-end of the market rises disproportionally fast under favorable macro-economic conditions, while rents also decrease faster in more challenging economic periods. A similar result is documented in Eichholtz et al. (2010b). Second, we have a limited number of buildings with an A-label in our sample, which may result in a "small sample" bias. Third, the threshold label requirement for the government (and some corporate tenants) is the C-label, and some building owners may have invested just enough to improve the energy efficiency of their inefficient buildings (i.e., with labels in lower categories) to the C or B level. These (unobservable) investments may be reflected in the higher premiums for buildings with C and B labels.

D. Dynamics

We also analyze the value of energy efficiency through time. Figure 4 shows a rental index for energy efficient office properties (green line) and for inefficient office properties (red line). This index is based on the quarterly change in rents for a portfolio of "green" buildings and a portfolio of "non-green" buildings, using exactly the same model as in Table 3, Column (4). These indices control for location and quality characteristics of the building.

Figure 4
Rent Index Efficient Office Buildings (Labels A, B and C) and Non-Efficient Office Buildings (Labels D and Lower)



Until the start of 2009, the rental developments were quite similar for both groups. The portfolio of "green" office properties had slightly stronger rental growth pre-crisis, but this growth disappeared soon after the start of the financial crisis, as vacancy rates started to increase following higher unemployment levels. As of 2009, however, there is a marked difference in the economic effect of energy efficiency. Controlling for location and year of construction, Figure 4 shows that "energy hogs" are currently facing relatively strong declines in rent, while more efficient office buildings show rental growth concomitantly. The aggregated effect of these opposite effects is large and provides an indication that sustainability (or at least energy efficiency) is capitalized by tenants in commercial property markets. Portfolios of real estate investors will certainly be affected by this trend.

5. Conclusions and Discussion

The interest of the real estate sector in energy efficiency and sustainability has been growing steadily over the past few years, notwithstanding the global economic downturn. There is a putative discussion on the costs and benefits of "greening" real estate, but building improvements in the commercial property sector have not taken off on a large scale yet. The apparent lack of investments in energy efficiency and sustainability is partially due to the substantial upfront, often on-balance, capital cost of building retrofits, which is reinforced by the current credit constraints among real estate investors (a direct effect of the financial crisis). In addition, the lack of systematic evidence on the returns to "greening" existing properties forms an important barrier to further inflow of private capital into building retrofits.

This paper adds to understanding better the economic value of energy efficiency and offers the first systematic, rigorous evidence on the market implications of EU energy performance certificates in the commercial property market. However, energy efficiency alone is just one of the variables comprised under sustainability, which also includes elements such as accessibility, water and waste management, indoor air quality and building management. This paper includes another tangible factor of sustainability: the location of a building relative to public transport, and accessibility of amenities, such as restaurants, retail and fitness facilities. European regulation is focused on the built environment, but there is no regulation with respect to urban transport as of yet. However, cities in for example, Italy, the Netherlands, Germany and the UK are currently experimenting with charges for vehicles (see Ekins and Lees, 2008, for a broader discussion of the impact of EU policies). Although speculative, it is not unimaginable that regulations targeted at urban transport become more widespread in the near future, thereby not only changing the outlook for the built environment but also increasing the importance of accessibility for tenants and building owners.

Our analysis of some 1,100 recent rental transactions in the Netherlands provides evidence that, on average, a less efficient, "non-green" office building achieves a 6.5 percent lower rent as compared to similar buildings with a "green" energy label. Importantly, we control for the most important determinants of rental values of office buildings, such as location, building vintage and size. Besides the "discount" for office buildings with labels indicating lower levels of energy efficiency, the results show that train stations represent a positive externality for corporate tenants – for every kilometer increase in distance to the nearest railway station, rents decrease with some 13 percent. Facilities in the direct vicinity of buildings have a positive effect on rents as well.

Many property markets currently face historically high vacancy rates. In the Netherlands, for example, it is estimated that about 14 percent of the building stock is vacant. The poisonous combination of low economic growth, a shrinking labor force and a changing perspective on the use of office space will negatively affect the outlook for some office markets. In addition, corporate tenants are increasingly making the transition to more innovative ways of working. The "New World of Work" represents a range of physical, technological and behavioral changes that enable office workers to be more efficient and save real estate related costs for the employer. Besides limiting the square meters per employee, this also changes the view on the design and surroundings of a building, with buildings increasingly viewed as meeting point rather than purely a place to work. The "life" around office buildings becomes more and more important. Our results show that tenants already pay higher rents for space in offices with a broad palette of amenities in the direct vicinity, as compared to space in offices at mono-functional locations. If the trend of new ways of working continues, the discount for more traditional office locations, without facilities in the direct neighborhood, may increase further. Moreover, data on the location of offices in our sample shows that buildings with less efficient labels are generally located further away from railway stations. As location is fixed in time, these offices will to a lesser extent be able to profit from the broadening of the sustainability theme and the corresponding valuation of accessibility by public transport.

The results in this study provide a clear market indication that sustainability matters for real estate users, which is directly in line with recent evidence for he U.S. office market (Eichholtz et al., 2010, in press). Our findings have important implications for the portfolios of investors in the European office market and beyond. Rental growth in efficient and less efficient buildings differs markedly. Accessibility pays as well. Both components of sustainability have a direct impact on the valuation of "non-green," inefficient buildings as well as offices at traditional, mono-functional locations.

Real estate appraisers can use the tangible results in this paper to integrate the most important elements of sustainability (energy efficiency, accessibility and availability of amenities) in the valuation of properties: less sustainable implies lower income (and quite possibly higher risk). Banks and other real estate financiers can exploit the measurable elements of sustainability in the evaluation of existing and prospective lending agreements. For less efficient office properties that are not adequately improved, situated in areas without direct access to railway stations and amenities, the credit risk faced by banks may be affected through lower cash flows, which may put the debt service coverage ratio (DSCR) or the interest coverage ratio (ICR) in jeopardy. The credit risk may also be affected by lower values of financed properties, leading to a higher loan to value ratio (LTV).

Importantly, this research offers insight into the profit opportunities of building retrofits as well. Sustainability is here to stay for real estate investors. Innovative financing mechanisms, such as "retrofit funds," ESCO's or "on bill" financing through utility companies, enable large-scale inflows of private capital to invest in energy efficiency. Using third-party capital, real estate investors can improve the quality of their real estate portfolio, profit from lower operational costs, enjoy an improvement in the marketability of properties and, ultimately, are hedged against market and macroeconomic trends that will affect the value of their property portfolio. This way, the transition to a more sustainable built environment not only contributes to lower CO_2 levels (ultimately leading to a low-carbon economy), but in tandem, it will yield the opportunity for the creation of shareholder value through energy efficiency and a decrease in sustainability-related financial risks.

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