



# Energy efficiency and economic value in affordable housing



Andrea Chegut<sup>a</sup>, Piet Eichholtz<sup>b,\*</sup>, Rogier Holtermans<sup>b</sup>

<sup>a</sup> MIT, Cambridge, MA, United States

<sup>b</sup> Maastricht University, The Netherlands

## HIGHLIGHTS

- Dutch affordable housing suppliers recoup sustainability investment by selling dwellings.
- Energy-efficient affordable dwellings sell at a premium.
- A-labeled dwellings are 7% – 11,000 euros – more valuable than C-labeled ones.
- Household characteristics do influence the sustainability premiums, but only slightly.

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## ABSTRACT

Strong rental protection in the affordable housing market often prohibits landlords from charging rental premiums for energy-efficient dwellings. This may impede (re)development of energy efficient affordable housing. In the Netherlands, affordable housing institutions regularly sell dwellings from their housing stock to individual households. If they can sell energy efficient dwellings at a premium, this may stimulate investments in the environmental performance of homes.

We analyze the value effects of energy efficiency in the affordable housing market, by using a sample of 17,835 homes sold by Dutch affordable housing institutions in the period between 2008 and 2013. We use Energy Performance Certificates to determine the value of energy efficiency in these transactions. We document that dwellings with high energy efficiency sell for 2.0–6.3% more compared to otherwise similar dwellings with low energy efficiency. This implies a premium of some EUR 3,000 to EUR 9,700 for highly energy efficient affordable housing.

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## 1. Introduction

Approximately 27% of aggregate energy use in the European Union's member states stems from the residential sector (Bertoldi et al., 2012). In 2010, this resulted in an estimated 225 billion euro energy bill and 630 million tons of CO<sub>2</sub> emissions for the European housing sector.<sup>1</sup>

\* Correspondence to: Maastricht University, Department of Finance, PO Box 616, 6200 MD Maastricht, The Netherlands.

E-mail addresses: [achegut@mit.edu](mailto:achegut@mit.edu) (A. Chegut),

[p.eichholtz@maastrichtuniversity.nl](mailto:p.eichholtz@maastrichtuniversity.nl) (P. Eichholtz),

[r.holtermans@maastrichtuniversity.nl](mailto:r.holtermans@maastrichtuniversity.nl) (R. Holtermans).

<sup>1</sup> These estimates are based on the average electricity and gas price statistics for the EU-27 as provided by Eurostat (2013) and the total electricity and gas consumption figures for the residential sector from Bertoldi et al. (2012). The average electricity and gas prices for households in the EU-27 in 2010 were respectively 17.3 and 5.7 Eurocent per kWh. In that year, the residential sector's electricity consumption was 843 billion kWh and its gas consumption 1385 billion kWh. Multiplying these consumption figures with the average prices yields a total energy bill of approximately 225 billion euros in 2010. We convert these consumption statistics to kg of CO<sub>2</sub> emissions using a conversion factor of 0.445 for electricity and 0.184 for natural gas as documented by the Carbon Trust (2013).

This illustrates the economic importance of energy consumption in housing, and the European Union continues to encourage the uptake of energy efficiency measures in the built environment. The Energy Performance of Buildings Directive of 2003, its recast in 2010, the Energy Efficiency Plan of 2011 and the subsequent 80 billion euro Horizon 2020 energy efficiency stimulus package all aim to stimulate the improvement of energy efficiency and a reduction in energy demand from buildings through regulatory directives, energy efficiency measurement initiatives and financial incentives. On top of that, many member states have their own rules and incentives stimulating sustainability in the built environment.

This study looks at the financial outcomes of energy efficiency in an important and hitherto neglected segment of the housing market in the energy policy literature: the affordable housing sector. Affordable or public housing accounts for 17% of all housing in the EU as a whole. In Austria the sector represents 25% of the housing stock, while for Sweden and the U. K. these figures are respectively 20% and 18%. In many countries, it is the dominant form of rental housing (Whitehead and Scanlon, 2007). Yet,

despite its importance, this segment of the housing market has hardly been investigated in the literature studying the economic effects of energy efficiency. Its size alone makes it an important sector in the energy efficiency abatement discussion.

There are a number of studies investigating the impact of energy performance on the economic performance of real estate, as measured by rental value, occupancy, and transaction price. For commercial real estate these studies generally find higher rents and transaction prices for environmentally certified buildings relative to conventional buildings, as well as higher and more stable occupancy rates.<sup>2</sup>

In the housing market, the studies concentrating on the financial performance of energy efficiency are fewer in number. Generally, these housing studies also document higher transaction prices for energy efficient dwellings, and find that the size of these price differences depend on the level of energy efficiency (Brounen and Kok, 2011; Cerin et al., 2014; Feige et al., 2013; Hyland et al., 2013). However, almost all of these housing studies take the owner-occupied housing sector into account, which is just one component of the housing market.

Affordable or public housing institutions face significant financial constraints in repaying the investments in energy efficiency related building improvements. This is caused by a split-incentive problem, where building owners invest in energy efficiency for buildings and tenants benefit from the resulting lower energy bill. In many countries, affordable housing sector rents are capped or limited in their increases, which makes the repayment of energy efficiency building investments through increased rents very difficult. These split incentives are a large problem also in the Netherlands, where the affordable housing sector's 2.4 million dwellings account for 31% of the total housing stock (Autoriteit Woningcorporaties, 2012) and where rent increases are strongly regulated.

However, Dutch affordable housing institutions also regularly sell dwellings from their stock to individual households, so an alternative method to get compensated for investments in environmental performance is through the realization of a possible increase in the value of their assets as a result of these improvements. To date, however, there is no evidence showing whether or not this is indeed the case, and given the uncertainty regarding this matter, affordable housing institutions may well underinvest in energy efficiency improvements of their dwellings. The main research question of this paper is to shed light on this issue, by investigating whether energy efficiency is priced in affordable dwellings. We do that by examining a large sample of transactions of individual dwellings by Dutch affordable housing institutions.

To identify these improved energy efficient dwellings, we collect a sample of 17,835 transactions of affordable dwellings from the Netherlands' land registry, the Kadaster, in the period from 2008 until mid-2013 and link it to a database of Energy Performance Certificates (EPCs) maintained by the Netherlands Enterprise Agency (NEA).

The Energy Performance of Buildings Directive of 2003 stipulates the mandatory disclosure of the energy performance of buildings across all EU member states as of January 1, 2006. However, member states were granted an additional period of three years to implement the certification procedure. In the Netherlands all homeowners were obliged to provide an EPC upon the sale of their house (older than 10 years) as of January 1, 2008. Nevertheless, due to opposition in the Dutch parliament, homeowners were able to refrain from providing an EPC in case a waiver by both the selling and buying party was signed. Affordable

housing institutions were given an additional year to implement the EPC to their housing portfolios as long as they ensured full labeling of all dwellings.<sup>3</sup> So the incidence of transactions of housing with an EPC label went up substantially in 2008, but there were still many sales of unlabeled dwellings as well. As of 2015, Dutch law on this matter changed again, making the EPC label obligatory for all housing sales and rentals, without any exceptions.

We investigate the impact of energy efficiency on the transaction price per square meter in two ways. First, we estimate the value impact of energy labels in general, by comparing the transaction prices of labeled dwellings with those of non-labeled ones. About 42% of the dwellings in our sample have an Energy Performance Certificate, and we use the non-certified dwellings as the control sample.

Second, we study the energy labeled sample separately. This way, we can compare transactions of homes with high energy efficiency – those having an A or B label – with homes that are less energy efficient – having a label C through G, and it allows us to directly study the relationship between the energy performance index – on which the labels are based – and the prices of affordable homes.

In each of these settings, we analyze the relationship between energy efficiency and the transaction prices of affordable housing by employing a standard hedonic pricing model. This way, we control for building quality, location and general housing market conditions, as well as for thermal characteristics such as insulation quality.

We document that affordable dwellings with high-quality energy labels – Energy Performance Certificates of A or B – have higher transaction values than their otherwise comparable peers. Dwellings with an energy label of B or higher transact for 2.6% more compared to housing with label C or lower. Specifically, an A-labeled dwelling sells for 6.3% more, and a B-labeled dwelling for 2% more than an otherwise similar dwelling with a C label. This implies that the average affordable home with a C label in our sample would sell for almost EUR 9,700, more were it to transact as an A-labeled dwelling and for some EUR 3,000 more in case of a B label. These results suggest that although it may be difficult for affordable housing institutions to recover their investments in energy efficiency improvements directly through increased rents or reduced energy costs, they might be able to recover the investment, at least in part, at the time of sale.

In the remainder of this paper, we will first briefly discuss related studies focusing on the impact of energy-efficiency in the residential real estate sector. Thereafter, we will describe the Dutch affordable housing market, discuss the data and data sources we use for the analysis, and provide some sample statistics. The following sections present the method and the empirical results. The paper ends with a conclusion and a discussion of the policy implications of this study.

## 2. The housing market and the value of energy efficiency

The literature regarding the value of energy efficiency in housing markets in Europe, Asia, and the U. S. generally finds that homes and apartments that are certified as having low primary energy demand have higher transaction prices and/or rents. However, there are variations across the studies in the type of certification studied, the extent of environmental performance measures linked to the certification and the magnitude of the

<sup>2</sup> See, for example, Bonde and Song (2013), Chegut et al. (2014), Eichholtz et al. (2010, 2013), Fuerst and McAllister (2011), Kok and Jennen (2012).

<sup>3</sup> See Brounen and Kok (2011) for a more extensive discussion on the measurement of the Energy Performance Certificate.

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