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**Assessing the Impact of Energy
Efficiency on Real Estate Values:
A Hedonic Analysis in Padua, Italy**

**Bonardi Pellizzari, C., Franceschinis, C.,
Tempesta, T., Thiene, M., Vecchiato, D.**

Università degli Studi di Padova

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1. Introduction

1.1 Objective

Project **ENVALUE**: The role of the ENvironment and energy efficiency on house and farmland **VALUES**

Identify whether and to what extent **energy efficiency** influence the **real estate market** in the city of Padua



1. Introduction

1.2 Background

Energy Performance of Buildings
Directive **EPBD** ([2002/91/EC](#))



Energy Performance Certificate **EPC**



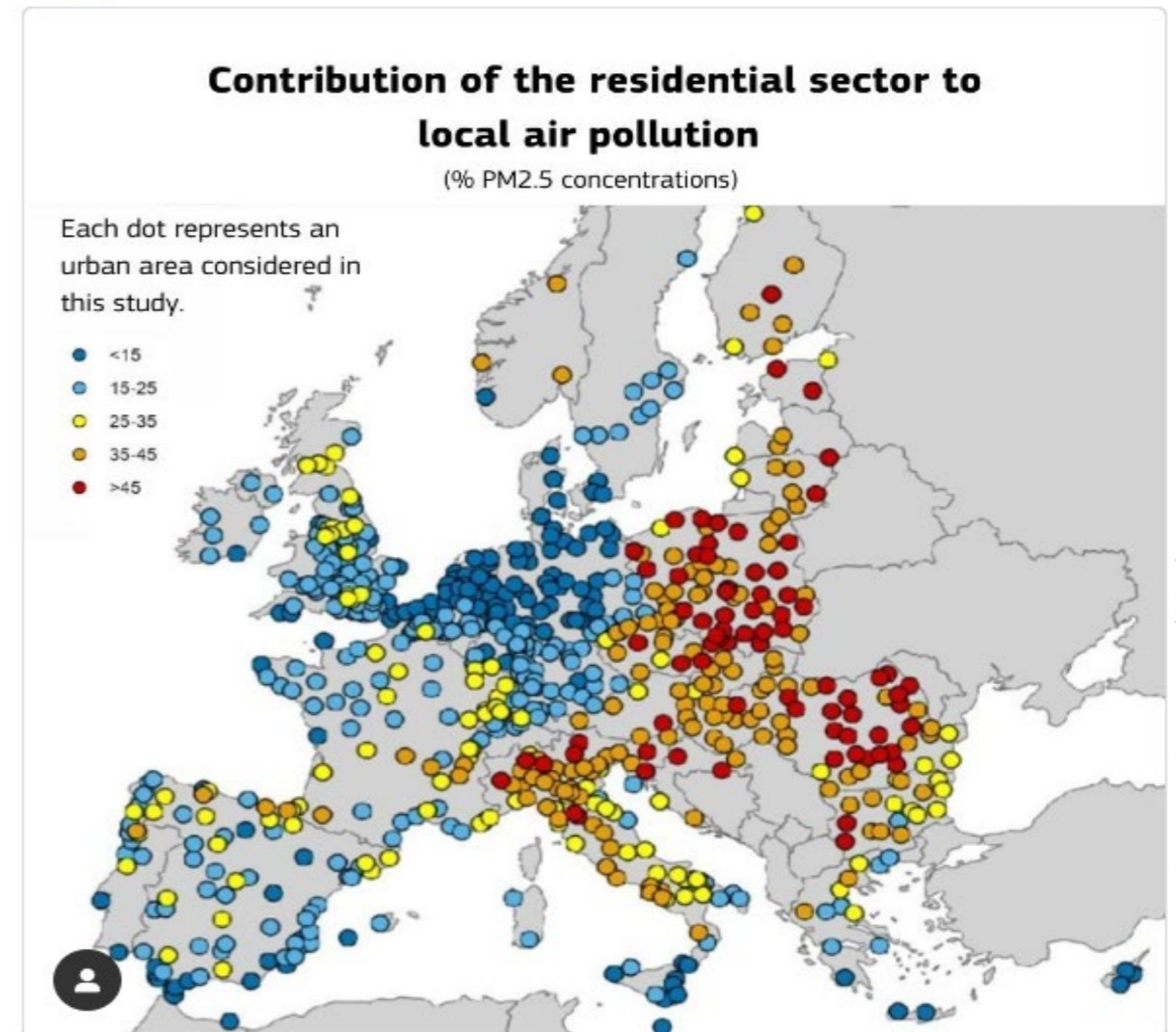
Green Deal ([2021](#))
carbon neutrality by 2050



EPBD **recast** (Directive EU [2024/1275](#))

Capitalization of EPC in property prices:

Price premium for best-performing
classes ([Fregonara & Rubino, 2021](#))



Buildings account for:



40%
of energy
consumed



36%
of energy-related
greenhouse gas
emissions



75%
of EU buildings
are not energy
efficient



85-95%
of EU buildings
are expected to
still be standing
in 2050

1. Introduction

1.3 Methodological background

Hedonic models

The price of a good on the market is determined by its characteristics or attributes. Consumers derive utility from individual attributes and the value of a good is the sum of these attributes ([Rosen, 1974](#); [Lancaster, 1966](#)).

$$P = \beta_0 + \sum \beta_k I_k + \sum \beta_j E_j + \varepsilon$$

Intrinsic characteristics

e.g. number of bedrooms,
surface area, year of
construction, EPC

Extrinsic characteristics

- **Non environmental:** e.g. social context, services
- **Environmental:** e.g. air quality, green areas

2. Material and methods

2.1 Study area



2. Material and methods

2.2 Data collection

Listings (asking prices)

- 712 observations (apartments)
- February 2022



Transactions (sales prices)

- 222 observations (apartments)
- July 2022 - February 2023

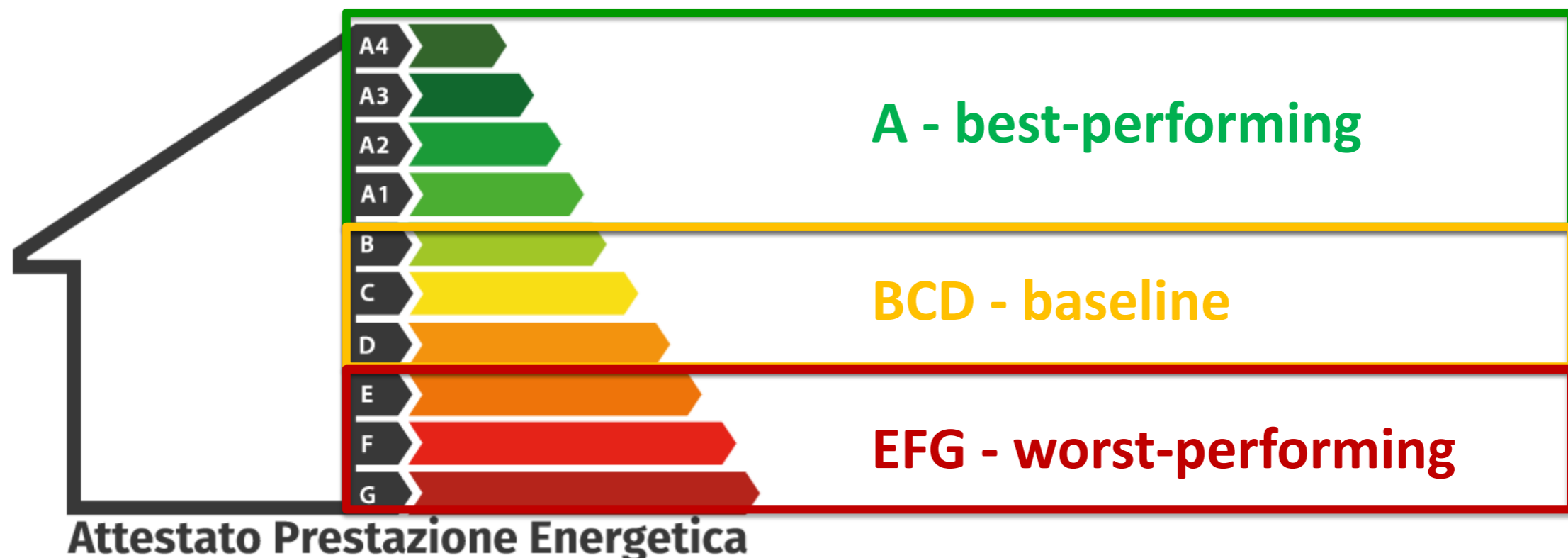


2. Material and methods

2.3 Data analysis

- **Multiple linear regression:** Ordinary Least Squares (OLS)
- **Semi-log:** the coefficients represent the percentage change in the price/m² of the house for a unit change in each attribute

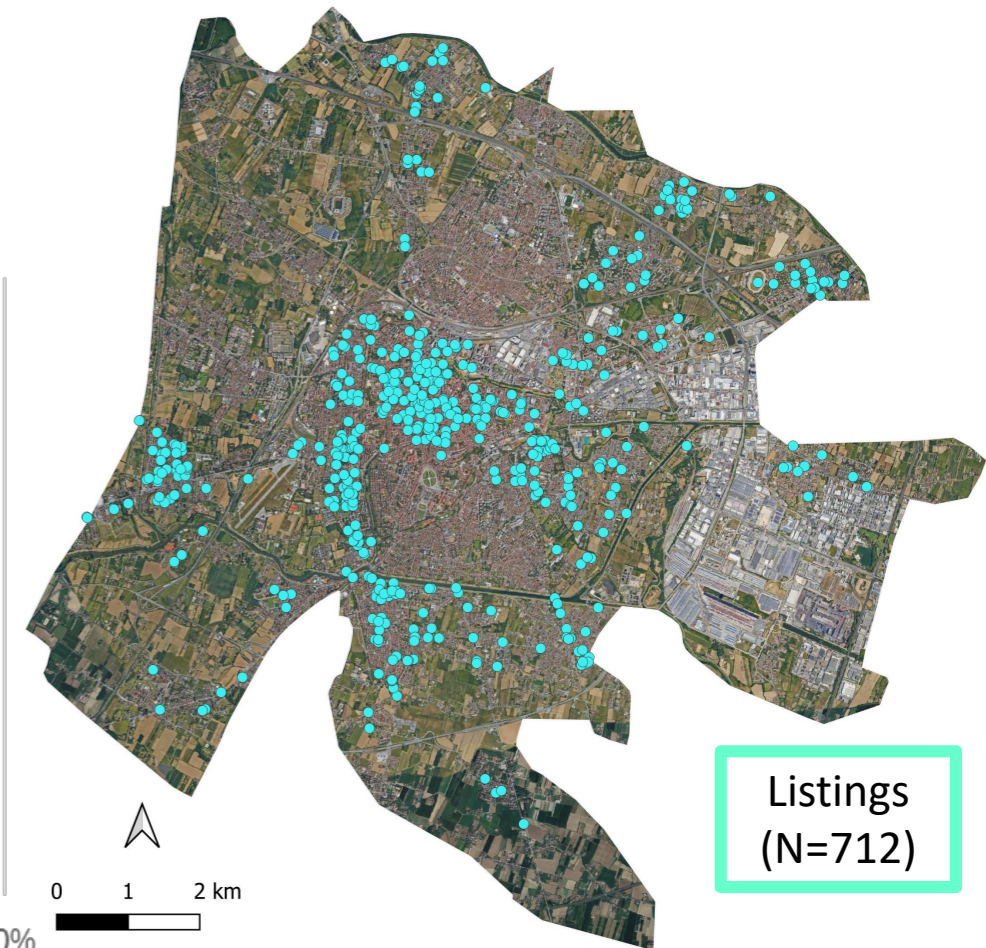
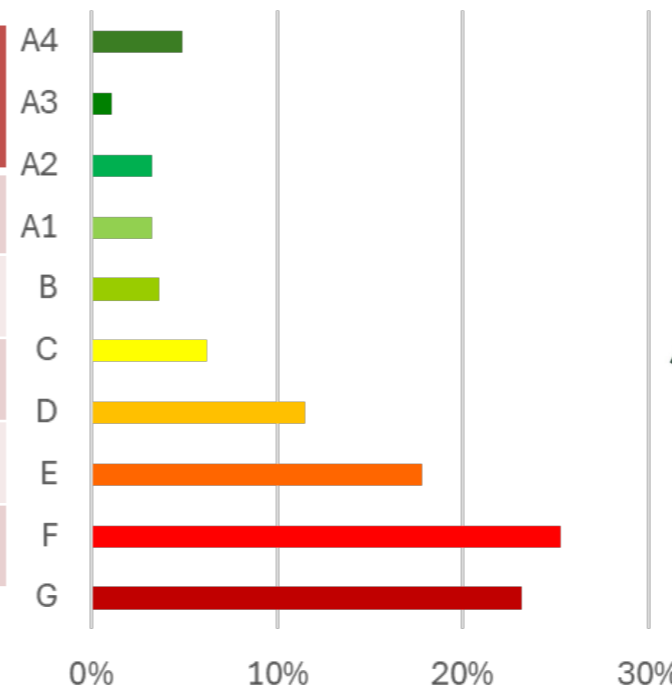
$$\ln(P/m^2) = \beta_0 + \beta_1 area + \beta_2 epc + \beta_3 zone$$



3. Results

3.1 Descriptive statistics

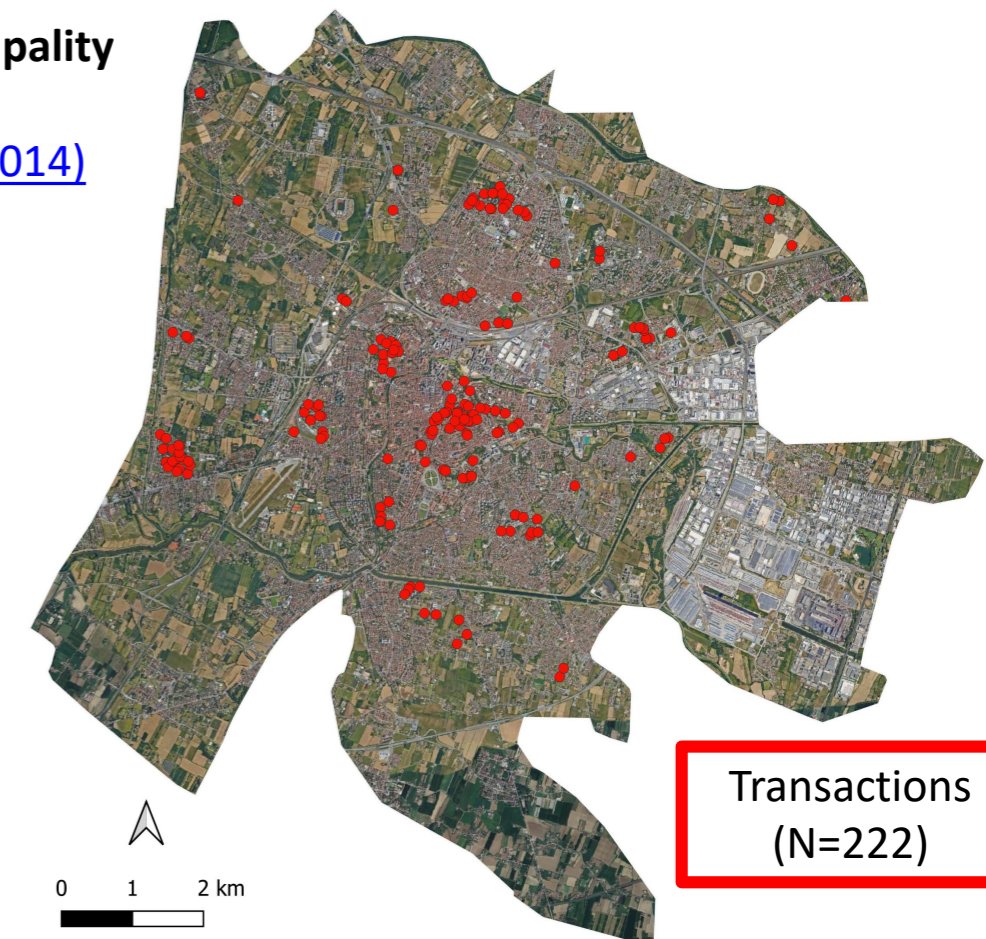
EPC	Listings (asking prices)		Transactions (sales prices)	
	n	%	n	%
A	159	22%	22	10%
BCD	111	16%	28	13%
EFG	442	62%	172	77%
Total	712	100%	222	100%



Price (€/m ²)	Listings (asking prices)	Transactions (sales prices)
N	712	222
Min	613.6	328.9
Q1	1488.0	1042.9
Median	2000.0	1607.3
Mean	2150.6	1836.8
Q3	2632.2	2390.5
Max	6217.9	4857.1

EPC distribution in the municipality of Padua in 2023

Source: [Regione del Veneto \(2014\)](#)





3. Results

3.2 Regression results

Listings (asking prices)

EPC (baseline BCD)

A: 40.9% (p-value<0.001)

EFG: - 17.1% (p-value<0.001)

R² = 0.583

712 observations

Transactions (sales prices)

EPC (baseline BCD)

A: 33.8% (p-value<0.001)

EFG: - 21.8% (p-value<0.001)

R² = 0.612

222 observations

4. Conclusions



- **Capitalization of energy efficiency in property prices**
- Higher capitalization for asking prices (increased energy costs coupled with regulations for the reduction of emissions)



- The use of **Big Data** collected with the **web crawling** technique resulted particularly effective, enabling the **rapid gathering of large samples** and therefore allows to overcome the difficulty of operating with real transaction data especially in the Italian or similar context, where data are available, but of difficult accessibility



- Although further research is needed to validate our results, the findings of this research shed light on the **interaction between sustainability and real estate valuation**, providing valuable information to support **urban planning and investors**



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Thank you! Grazie!

carolina.bonardipellizzari@phd.unipd.it