



The Economics of Energy Labels

Nils Kok

Haas/LBL @ UC Berkeley
Maastricht University

Dirk Brounen

RSM Erasmus

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Energy and buildings

Energy efficiency in built environment needs a trigger

- Stagnating trend in energy efficiency of buildings
 - After decades of substantial energy savings due to supply-side measures

- But real estate sector is still a major energy consumer...
 - 40% of global consumption raw materials (even 55% of wood)
 - 30% of global CO₂ emissions

- Awareness is growing
 - Legislation
 - US: Waxman-Markey bill
 - Europe: EPBD

- But...what about demand-side triggers?
 - Occupiers
 - Institutional investors



The power of (sound) economics

“Eco efficiency” and capital budgeting

- Investments in buildings may result in:
 1. Energy savings and emission reduction
 - Save on current resources
 - Insure against future price increases
 2. Higher transaction prices

- Signal of energy efficiency is priced in commercial real estate....
 - Eichholtz, Kok and Quigley (forthcoming AER)

- ...and this is mostly driven by a cheap, voluntary label

- What about private consumers? What about other property markets?

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 to 100) A		
(81 to 91) B	84	85
(69 to 80) C		
(55 to 68) D		
(39 to 54) E		
(21 to 38) F		
(1 to 20) G		
Not energy efficient - higher running costs		
England & Wales	EU Directive 2002/91/EC	

What happens at the other side of the ocean...

EPCs mandatory as of Jan 1, 2009

- Following the EPBD, the EU27 has introduced the Energy Performance Certificate (EPC) per January 2009
- Mandatory for all real estate transactions (commercial and residential; renting and buying)
- Netherlands, January 2008: Introduction of energy label in Dutch housing market → mixture of high (political) hopes and public dismay
- A deviation from the plan: the buyer can decide not to ask for an EPC...

...and the quality of the labeling process has been questioned

What is the signaling value of EPCs?

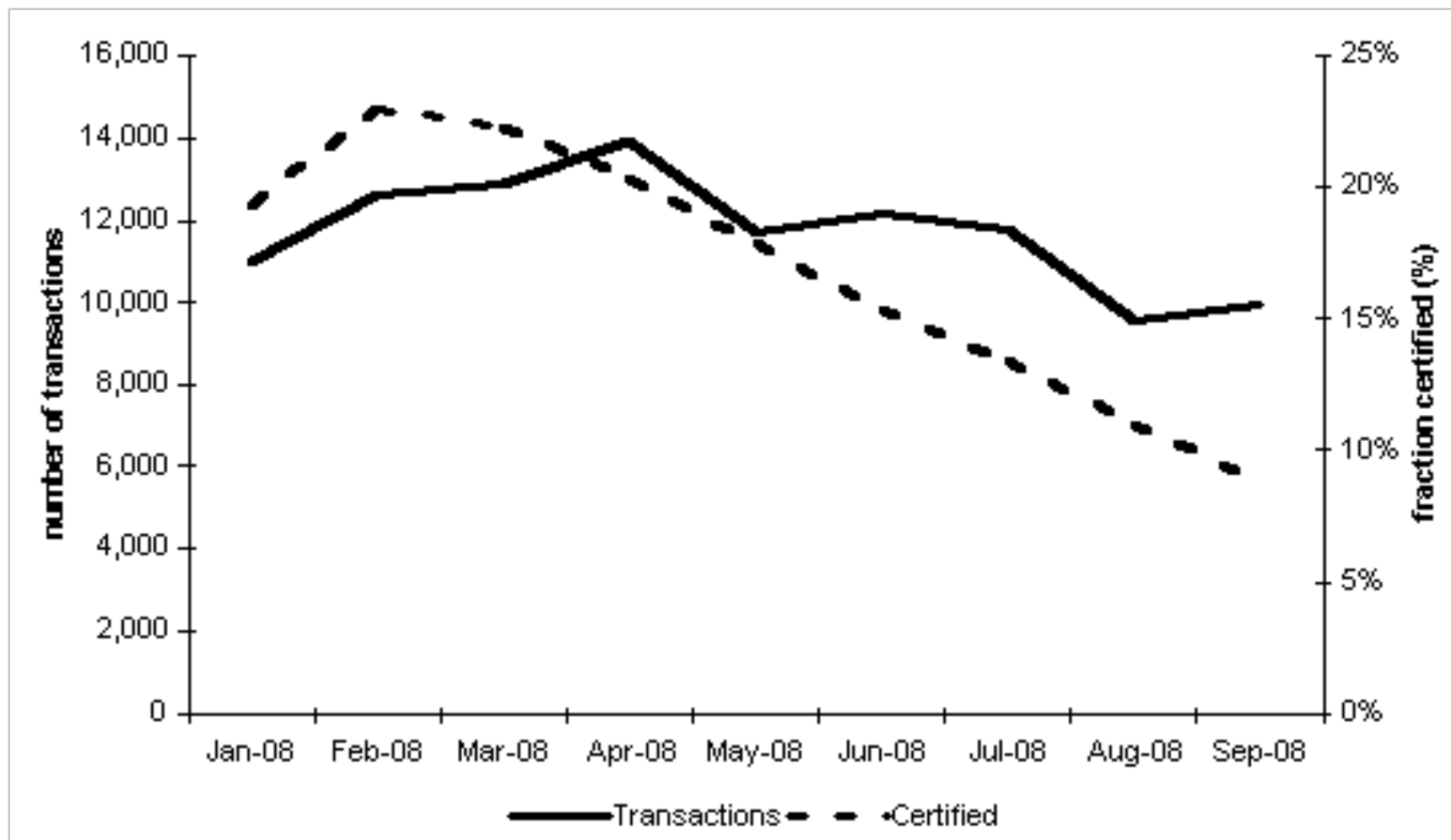
And are labels diffused in some systematic way?

- We analyze two things:
 1. The adoption process (innovation diffusion), who adopts? At which pace? And why?
 2. The effects of labels on the sale process, and why?

- We use Holland as a unique laboratory
 - Sample consists of over 100,000 home sales for the period January 2008 through September 2008
 - Label information is obtained from SenterNovem (incl. adoption date and label class)
 - Housing info is offered by NVM, the Dutch Realtor Association, incl. a wide variety on dwelling characteristics

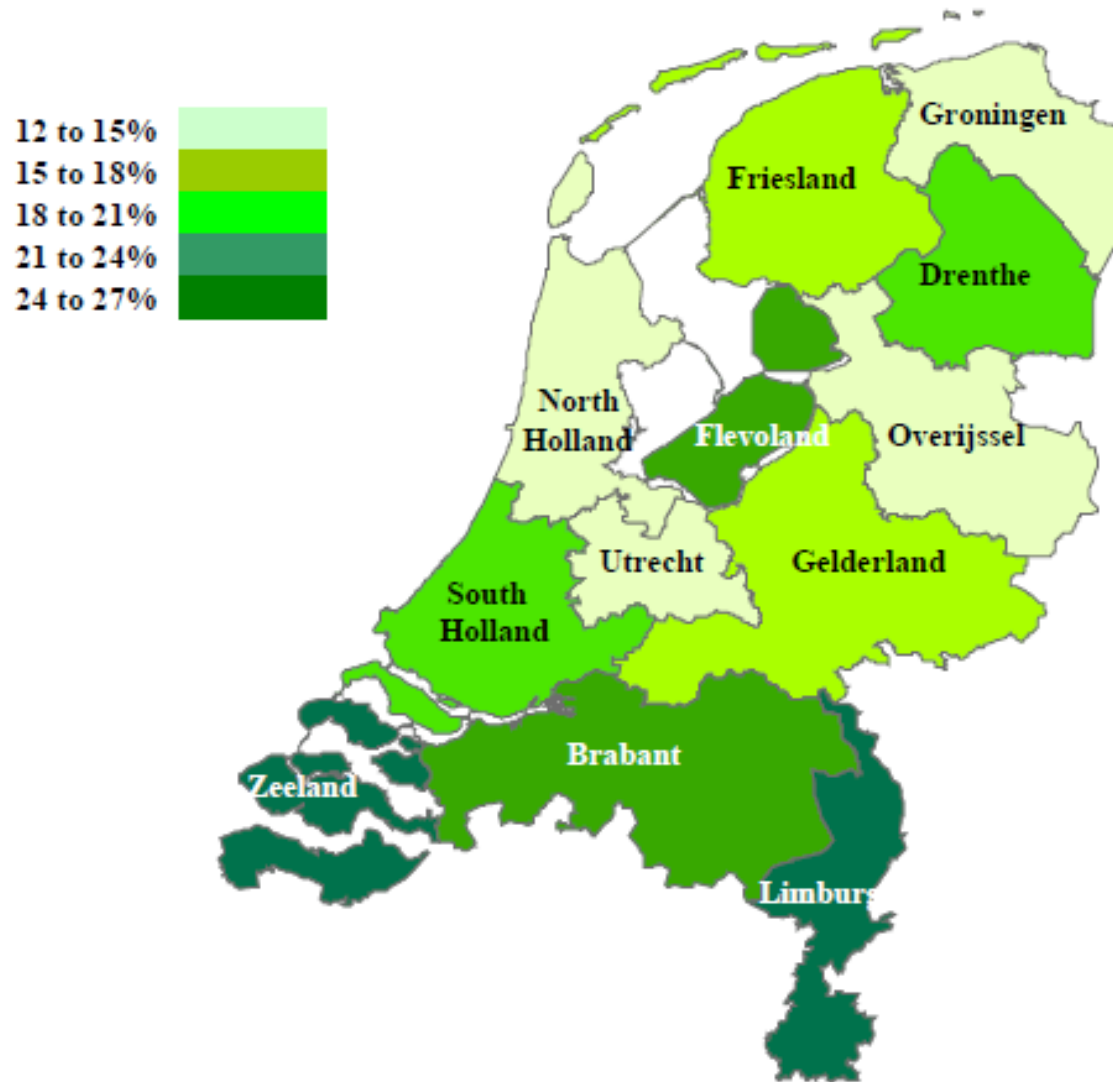
Adoption rate and adoption place

Diffusion slows down, but higher in “weak” regions



Adoption rate and adoption place

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Explaining the diffusion and adoption of labels

Who adopts a label in an almost voluntary setting?

- Methodology: logit framework

1.
$$EPC_{in} = \alpha + \beta_i X_i + \delta L_n + \varepsilon_{in}$$

EPC_{in} = dummy variable is one if building has an EPC, otherwise zero

X = vector of hedonic characteristics (e.g. age, size, quality, etc.)

L = vector of province dummies

Results (I)

Adoption rates driven by age and quality of dwelling

	(1)	(2)	(3)
Housing Type			
Corner	0.419 [0.029]***	0.421 [0.029]***	0.408 [0.030]***
Detached	0.293 [0.031]***	0.296 [0.033]***	0.279 [0.033]***
Semi-Detached	0.500 [0.028]***	0.490 [0.030]***	0.470 [0.030]***
Row	0.420 [0.023]***	0.418 [0.024]***	0.407 [0.024]***
Size (sq. m.)	0.073 [0.022]***	0.043 [0.022]***	0.023 [0.022]***
Period of Construction			
1906 – 1930	0.291 [0.049]***	0.291 [0.049]***	0.295 [0.049]***
1931 – 1944	0.436 [0.051]***	0.411 [0.052]***	0.417 [0.052]***
1945 – 1959	0.636 [0.051]***	0.567 [0.051]***	0.576 [0.051]***
1960 – 1970	0.706 [0.046]***	0.649 [0.047]***	0.650 [0.047]***
1971 – 1980	0.764 [0.046]***	0.712 [0.046]***	0.687 [0.046]***
1981 – 1990	0.808 [0.046]***	0.751 [0.047]***	0.655 [0.048]***
1991 – 2000	0.469 [0.047]***	0.415 [0.047]***	0.252 [0.050]***
> 2000	-2.374 [0.112]***	-2.430 [0.113]***	-2.628 [0.114]***

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Insulation			0.054 [0.006]***
Maintenance Interior			0.048 [0.013]***
Maintenance Exterior			-0.018 [0.015]
Constant	-2.701 [0.107]***	-2.112 [0.114]***	-2.264 [0.129]***
Pseudo R ²	0.039	0.046	0.047
Model Chi ²	3790.07	4498.95	4603.94
Sample Size	105431	105431	105431

The value of energy-efficient homes

The effect of a “green” label on transaction prices

- Methodology: standard valuation framework

$$(1) \quad \log P_{in} = \alpha + \beta_i X_i + \delta_n L_n + \gamma g_i + \varepsilon_{in}$$

$$(2) \quad \log P_{in} = \alpha + \beta_i X_i + \delta_n L_n + \gamma S_i + \varepsilon_{in}$$

P= Transaction price (per m²) or days on the market

X = vector of hedonic characteristics (e.g. age, size, quality, etc.)

L = vector of province dummies

g = dummy variable if building *i* has green label (A, B or C)

or

S= vector label score dummies (A – G)

Results: time on the market

Label has negative but insignificant effect on time on market

	All Segments		Apartments	
	(1)	(2)	(3)	(4)
Green Label	-2.935 [3.013]	-2.549 [3.065]	-2.412 [5.915]	-2.359 [6.003]
Size (log sq. m.)	8.806 [2.868]**	8.644 [2.885]**	29.309 [7.617]***	29.729 [7.621]***
Housing Type				
Corner	12.843 [3.825]***	14.679 [3.843]***		
Detached	87.502 [4.313]***	89.551 [4.338]***		
Semi Detached	29.262 [3.882]***	31.115 [3.905]***		
Row	-2.005 [2.187]	-0.427 [2.127]		
Period of Construction				
1906 – 1930	-5.810 [6.678]	-6.095 [6.674]	23.174 [14.223]	22.962 [14.231]
1931 – 1944	-17.618 [7.014]*	-18.564 [7.013]**	23.815 [14.619]	23.128 [14.667]
1945 – 1959	2.756 [6.869]	2.495 [6.866]	48.845 [14.117]***	48.515 [14.142]***
1960 – 1970	6.122 [6.316]	5.745 [6.314]	41.244 [13.304]**	41.406 [13.335]**
1971 – 1980	10.954 [6.225]	11.122 [6.224]	45.724 [13.695]***	45.328 [13.713]***
1981 – 1990	7.883 [6.465]	10.747 [6.542]	50.949 [13.973]***	47.524 [14.055]***
1991 – 2000	13.183 [6.798]	17.546 [6.996]*	72.887 [14.457]***	67.336 [14.817]***
> 2000	26.036 [16.343]	29.917 [16.450]	60.222 [23.980]*	57.221 [24.207]*

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1971 – 1980	10.954 [6.225]	11.122 [6.224]	45.724 [13.695]***	45.328 [13.713]***
Regional Dummies	Yes	Yes	Yes	Yes
Constant	101.331 [15.022]***	71.667 [17.667]***	-5.197 [39.894]	40.619 [46.385]
R ² -adj	0.062	0.063	0.040	0.041
Observations	18176	18176	3991	3991

Results: transaction price per m²

“Green” label enhances value (3.4 – 4.7%)

	All Segments		Apartments	
	(1)	(2)	(3)	(4)
Green Label	0.054 [0.006]***	0.034 [0.006]***	0.066 [0.010]***	0.047 [0.010]***
Size (log sq. m.)	-0.579 [0.006]***	-0.592 [0.006]***	-0.316 [0.013]***	-0.323 [0.013]***
Housing Type				
Corner	0.167 [0.008]***	0.175 [0.008]***		
Detached	0.662 [0.009]***	0.666 [0.009]***		
Semi Detached	0.337 [0.008]***	0.342 [0.008]***		
Row	0.086 [0.006]***	0.094 [0.006]***		
Period of Construction				
1906 – 1930	-0.046 [0.013]***	-0.046 [0.013]***	-0.157 [0.025]***	-0.143 [0.024]***
1931 – 1944	-0.060 [0.014]***	-0.065 [0.014]***	-0.375 [0.025]***	-0.352 [0.025]***
1945 – 1959	-0.148 [0.014]***	-0.146 [0.013]***	-0.335 [0.025]***	-0.313 [0.024]***
1960 – 1970	-0.178 [0.013]***	-0.180 [0.012]***	-0.397 [0.023]***	-0.377 [0.023]***
1971 – 1980	-0.122 [0.012]***	-0.129 [0.012]***	-0.315 [0.024]***	-0.297 [0.023]***
1981 – 1990	-0.124 [0.013]***	-0.139 [0.013]***	-0.281 [0.024]***	-0.265 [0.024]***
1991 – 2000	-0.027 [0.014]*	-0.055 [0.014]***	-0.123 [0.025]***	-0.126 [0.025]***
> 2000	0.025 [0.033]	-0.025 [0.032]	-0.117 [0.042]**	-0.136 [0.041]***

Results: transaction price per m²

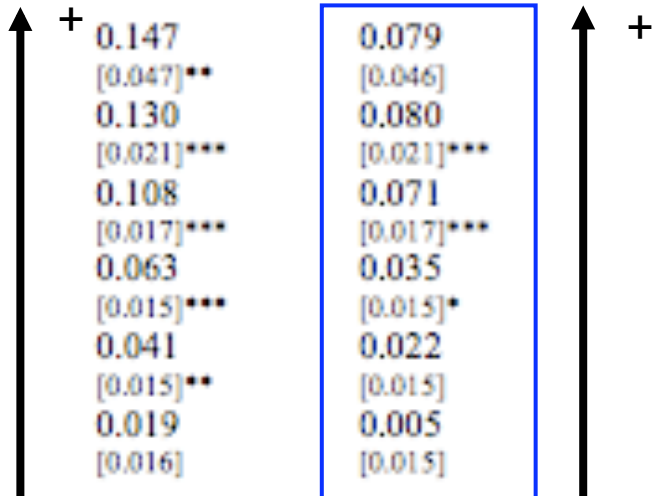
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Corner	0.167 [0.008]***	0.175 [0.008]***		
Detached	0.662 [0.009]***	0.666 [0.009]***		
Semi Detached	0.337 [0.008]***	0.342 [0.008]***		
Row	0.086 [0.006]***	0.094 [0.006]***		
Insulation		0.007 [0.002]***		0.007 [0.003]**
Maintenance Interior		0.038 [0.003]***		0.040 [0.004]***
Maintenance Exterior		0.027 [0.004]***		0.029 [0.007]***
Regional Dummies	Yes	Yes	Yes	Yes
Constant	10.023 [0.030]***	9.643 [0.035]***	9.081 [0.069]***	8.609 [0.079]***
R ² -adj	0.495	0.510	0.424	0.451
Observations	18176	18176	3991	3991

Results: transaction price per m²

The “greener” the better (?)

	All Segments		Apartments	
	(1)	(2)	(3)	(4)
Energy Performance Certificate				
Label A	0.198 [0.026]***	0.121 [0.026]***	0.147 [0.047]**	0.079 [0.046]
Label B	0.135 [0.012]***	0.069 [0.013]***	0.130 [0.021]***	0.080 [0.021]***
Label C	0.100 [0.010]***	0.043 [0.011]***	0.108 [0.017]***	0.071 [0.017]***
Label D	0.066 [0.010]***	0.019 [0.010]	0.063 [0.015]***	0.035 [0.015]*
Label E	0.052 [0.010]***	0.014 [0.010]	0.041 [0.015]**	0.022 [0.015]
Label F	0.025 [0.010]*	-0.000 [0.010]	0.019 [0.016]	0.005 [0.015]



Driver of premium: the gas bill or intangibles?

The premium can partially be explained by energy efficiency

- An average Dutch household consumed 1550 m³ of gas during 2008
 - 3% cooking, 19% warming water, 78% heating
 - This was 2100 m³ in 1996
 - The gas price in 2008 was €0.61/m³
 - So, in 2008 the average household had a monthly gas bill of €77
 - This, however, varied vastly across the market, in 2008 the range was €53 (A-label) to €162 (G-label)
1. We discount this spread (assuming 12 years of ownership)
 2. We calculate the spread as a fraction of the transaction price (ie. the premium that could be paid based on energy efficiency alone)

	A	B	C	D	E	F
Apartments	3.3%	2.8%	2.4%	1.9%	1.4%	0.8%
Houses	5.9%	5.4%	4.7%	3.7%	2.6%	1.3%

3. We compare the “energy efficiency” premium to the observed label premium:

Gas-portion	45%	55%	65%	70%	110%	130%
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Conclusions and implications

“Green” label effectively reflects energy efficiency

- Demand-pull is necessary to reduce carbon impact of built environment
- Voluntary labels can help in creating transparency in energy efficiency
- The EPC seems to be effective (in this regard): we document a price premium that varies with the label outcome, which is driven for a large part by future energy savings
- **A quality signal in an otherwise intransparent market**
- But...a clear, consistent and reliable signal is a prerequisite



Questions? Remarks?

N.Kok@maastrichtuniversity.nl