

The distribution of vulnerability to high energy prices across heterogeneous households in the Netherlands

TNO innovation
for life



**Utrecht
University**

Peter Mulder

Anika Batenburg, Francesco Dalla Longa,
Berend Hopman, Mauricio Rodriguez

Vulnerability of households (hh) to energy transition, beyond energy poverty

What is the relation between
energy costs, home quality, home
ownership, income and location?



Based on micro data (87% of all hh)

36 hh groups

- * Income – 4 levels**
(low, mid-low, mid-high, high)
- * Energy quality house – 3 classes**
(high, low, very low)
- * Ownership – 3 categories**
(Own property, commercial rent, social rent)

3 Different levels of energy prices (Low (2020), medium (mid 2023[#]) high (mid 2022))

[#] Estimate 2025-2040



Micro data

- **Anonimised data at individual and household level**

- Income, savings, debts, household composition
- Energy use, energetic quality of houses
- House type, age, size, status (rental, owner), market value ('WOZ waarde')
- Location

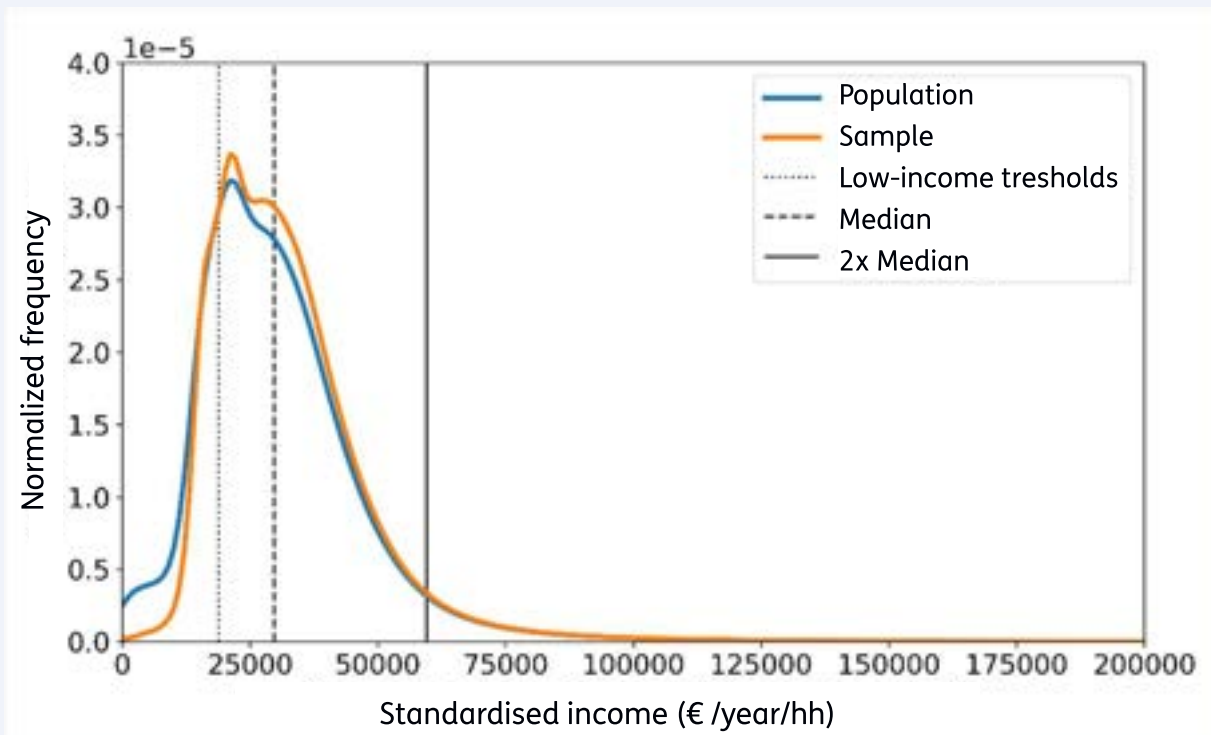
- **Dataset**

- Households: 7.037.400 (87% of total)
- Municipalities: 355 (100%)
- Neighborhoods: 3,018 'wijken' (97%)



NL Statistics

Income groups



Label	Euro/year	Description
Low	< €18.871	< 130% low-income threshold
Mid-low	€18.871 - €29.769	Low to median
Mid-high	€29.769 - €59.538	Median - 2x median
High	> €59.538 euro	> 2x median

Standardised income = disposable income corrected for household size and composition

Energy quality houses

Label	CBS indicator	Definition
High	Non-LEK	~ energylabel (EPC) A, B, C
Low	LEK	~ energylabel (EPC) D & E
Very low	ZLEK	~ energylabel (EPC) F & G ; 15% poorest insulated homes

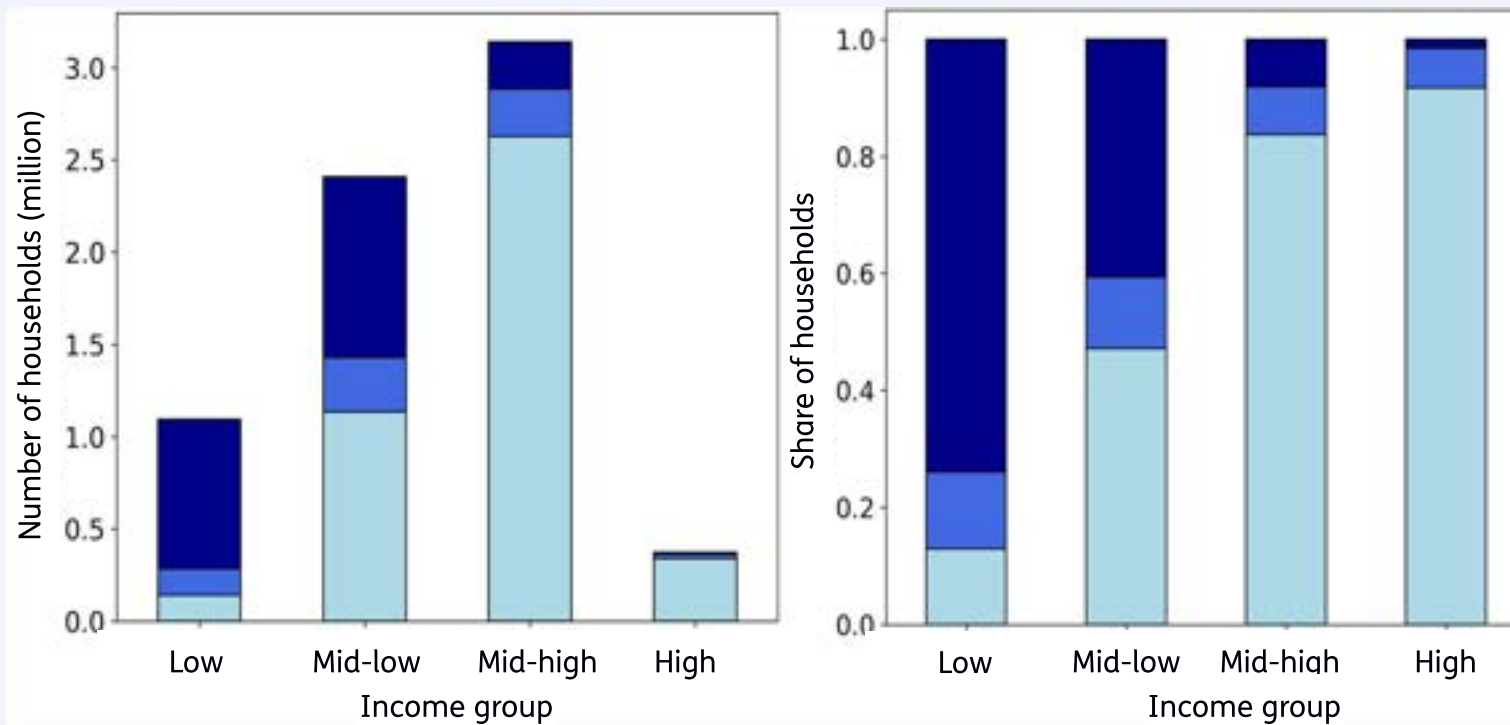


Calculated by NL Statistics (CBS), based on:

- Registered energy labels, insofar available
- Imputed energy labels, based on energy consumption, home characteristics; reference houses with energy labels

Ownership

Own house / Commercial rent / Social rent

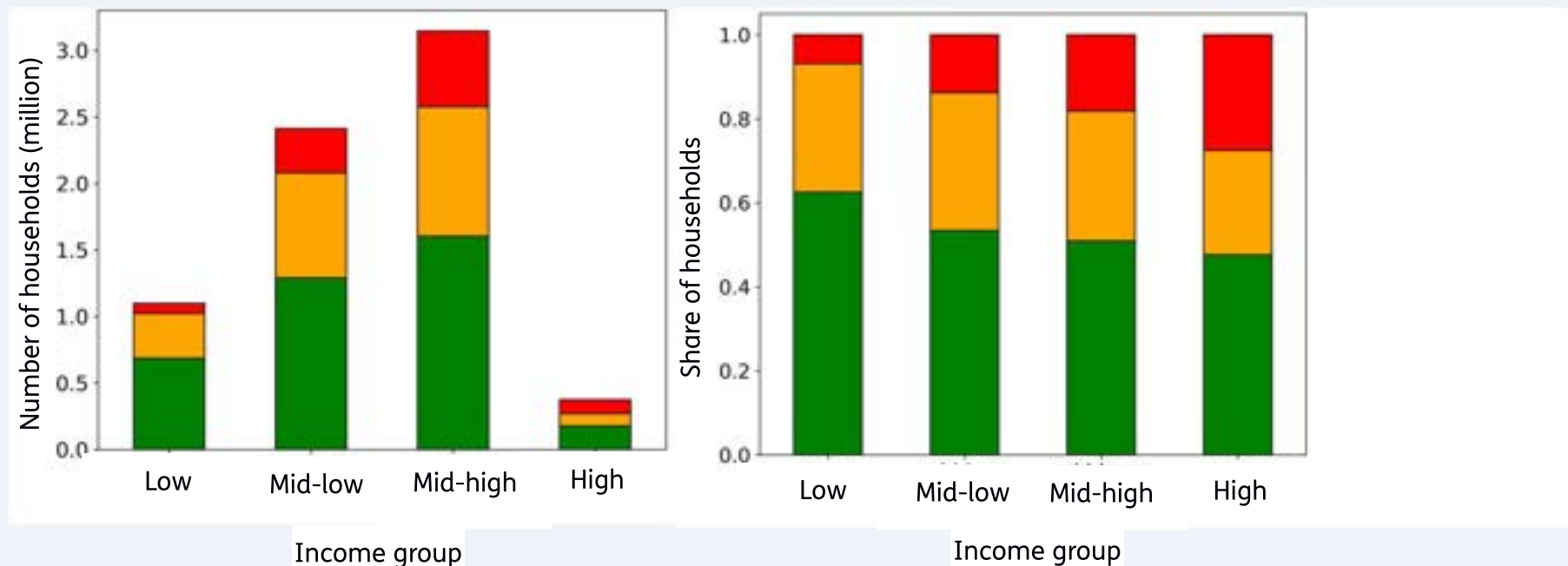


Key results



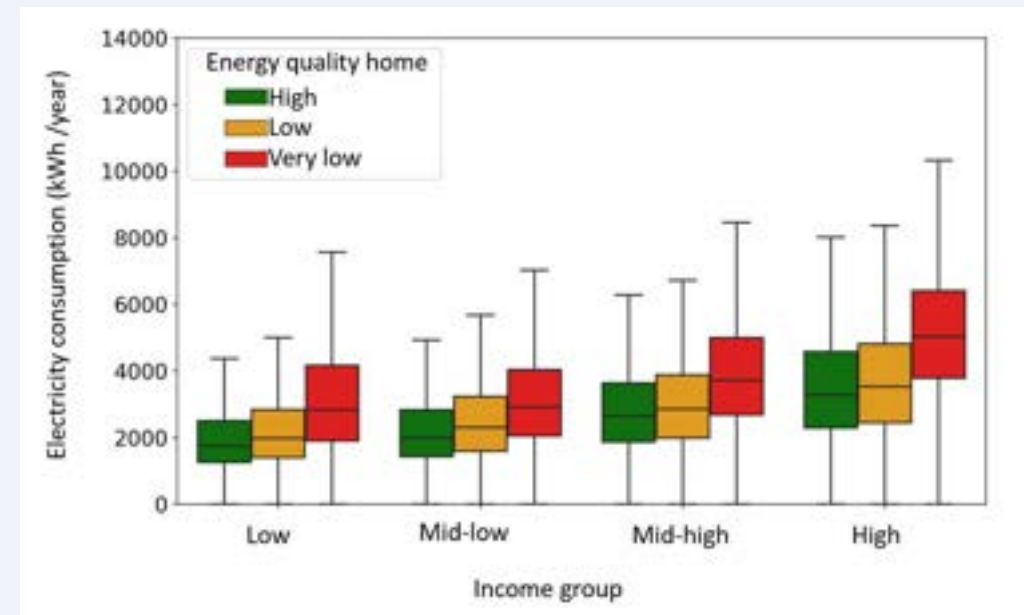
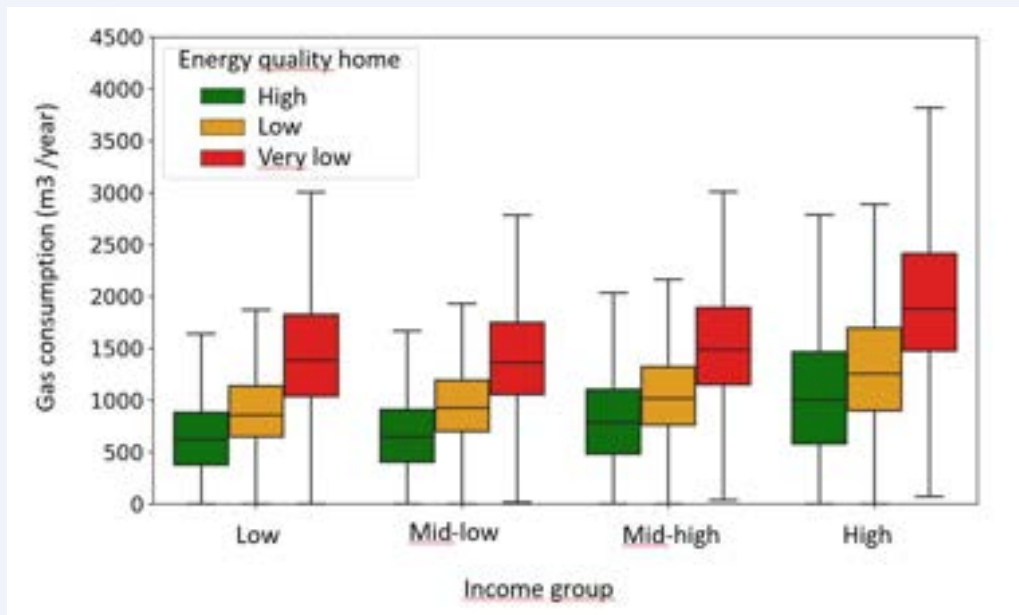
Low correlation Income & Energy quality house

■ High / ■ Low / ■ Very Low Energy quality house



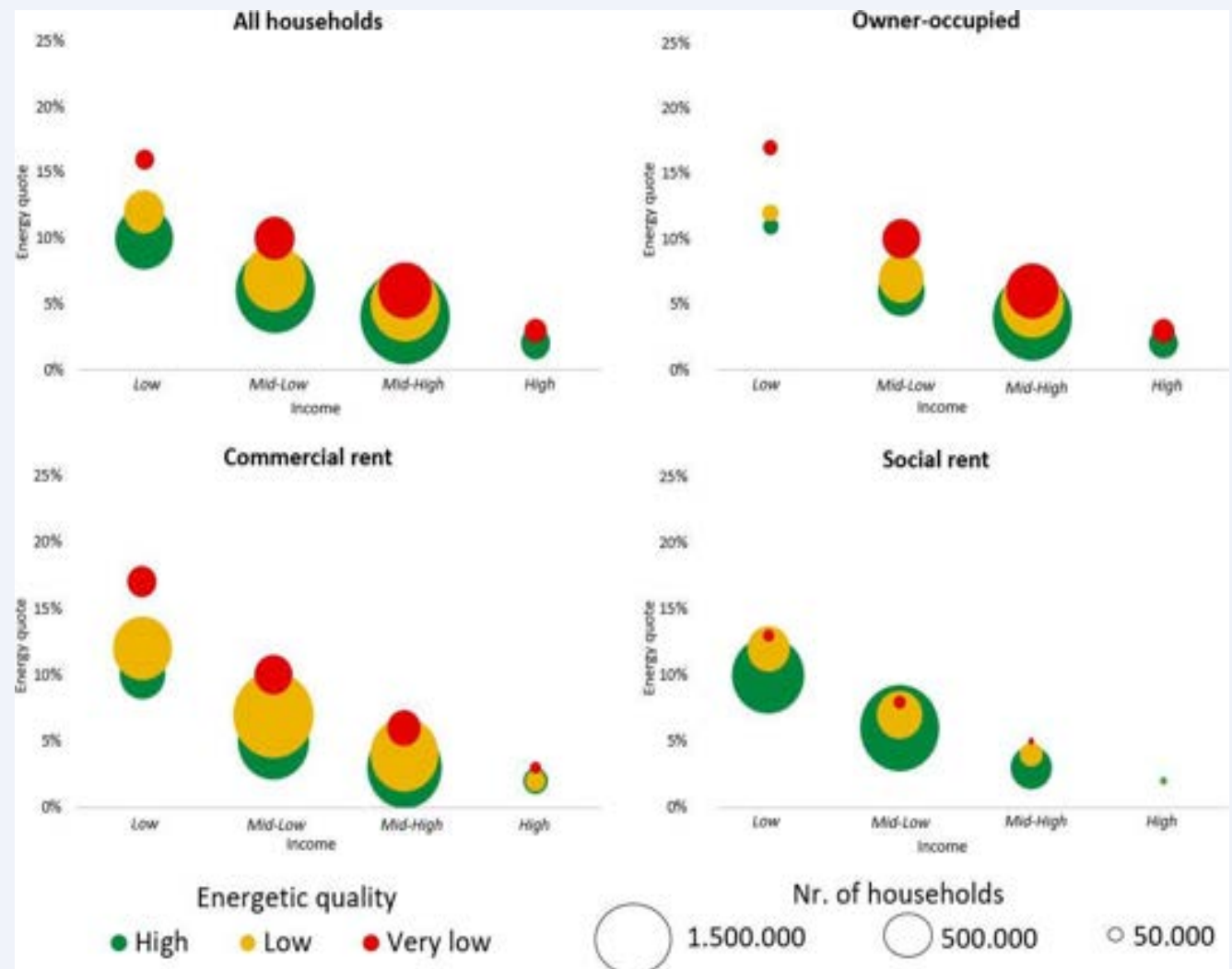
Exclusive policy focus on low energy quality houses does not necessarily helps the poor

Energy use correlates with energy quality house (rather than income)



- Generic differentiation of energy prices (social tariff for 'basic energy consumption') does not make much sense:
 - It's a de facto tax on low income hh with low energy quality house and therefore high energy consumption
 - It's a de facto subsidy to high income hh with high energy quality house and therefore low energy consumption

Distribution of households



Distribution of households

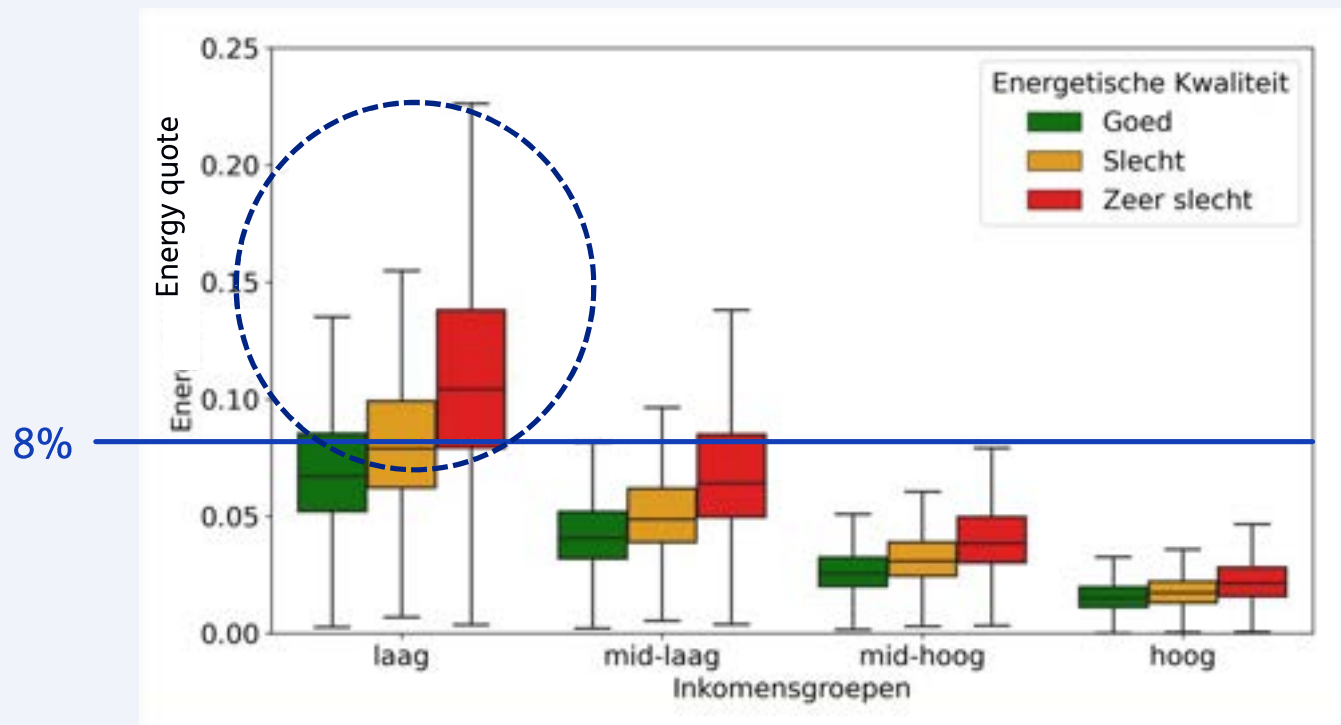
- Income class vs energy quality class

	Energy quality home (LEK)							
Income group	High	Low	Very low	TOTAL	High	Low	Very low	TOTAL
Low	9,8%	4,8%	1,1%	15,6%	686.248	336.380	75.252	1.097.880
Mid-low	18,3%	11,3%	4,7%	34,3%	1.288.369	792.030	332.903	2.413.302
Mid-high	22,8%	13,8%	8,1%	44,7%	1.602.487	971.676	571.323	3.145.486
High	2,5%	1,3%	1,5%	5,3%	177.564	92.824	102.829	373.217
TOTAL	53,4%	31,2%	15,4%	100,0%	3.754.668	2.192.910	1.082.307	7.029.885

At low energy price, low income hh already vulnerable

Scenario low energy price (2020 level)

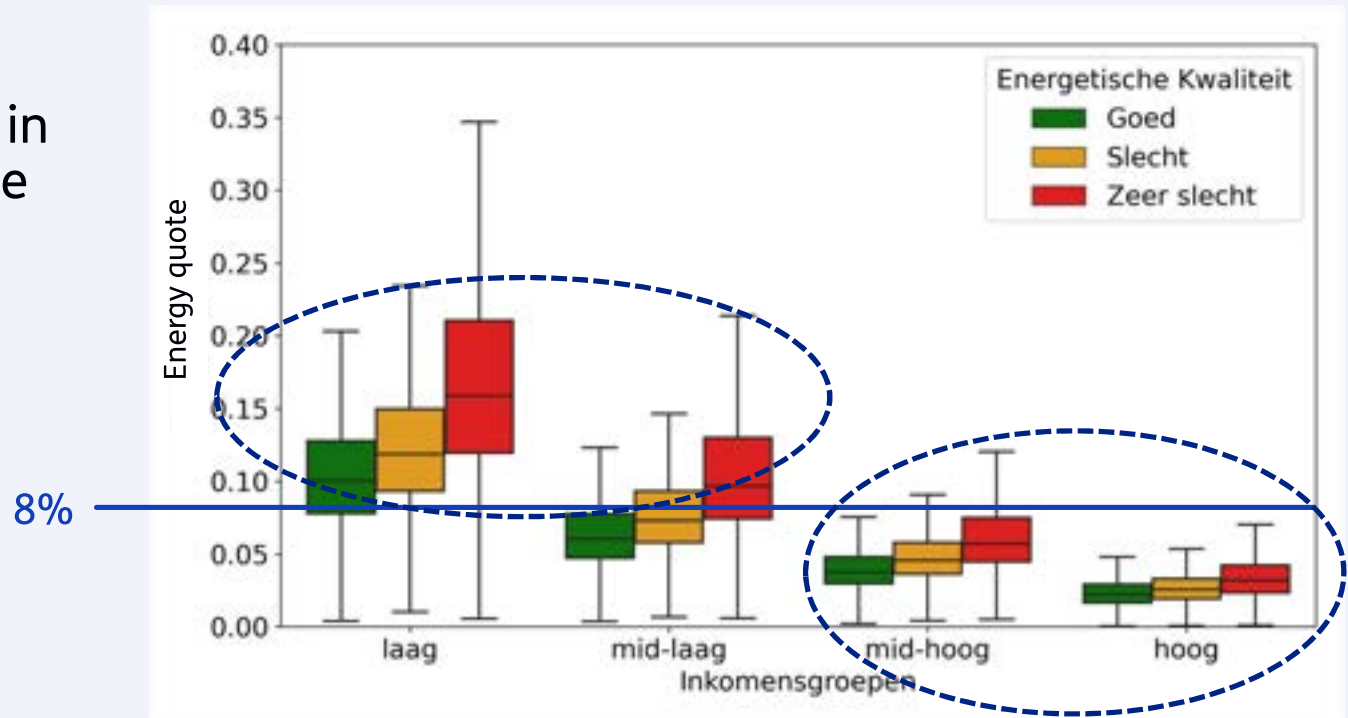
- Lowest income group is always vulnerable
- Especially in low energy quality house



At medium energy price, 'vulnerability dichotomy'

Scenario medium energy price (2023 level)

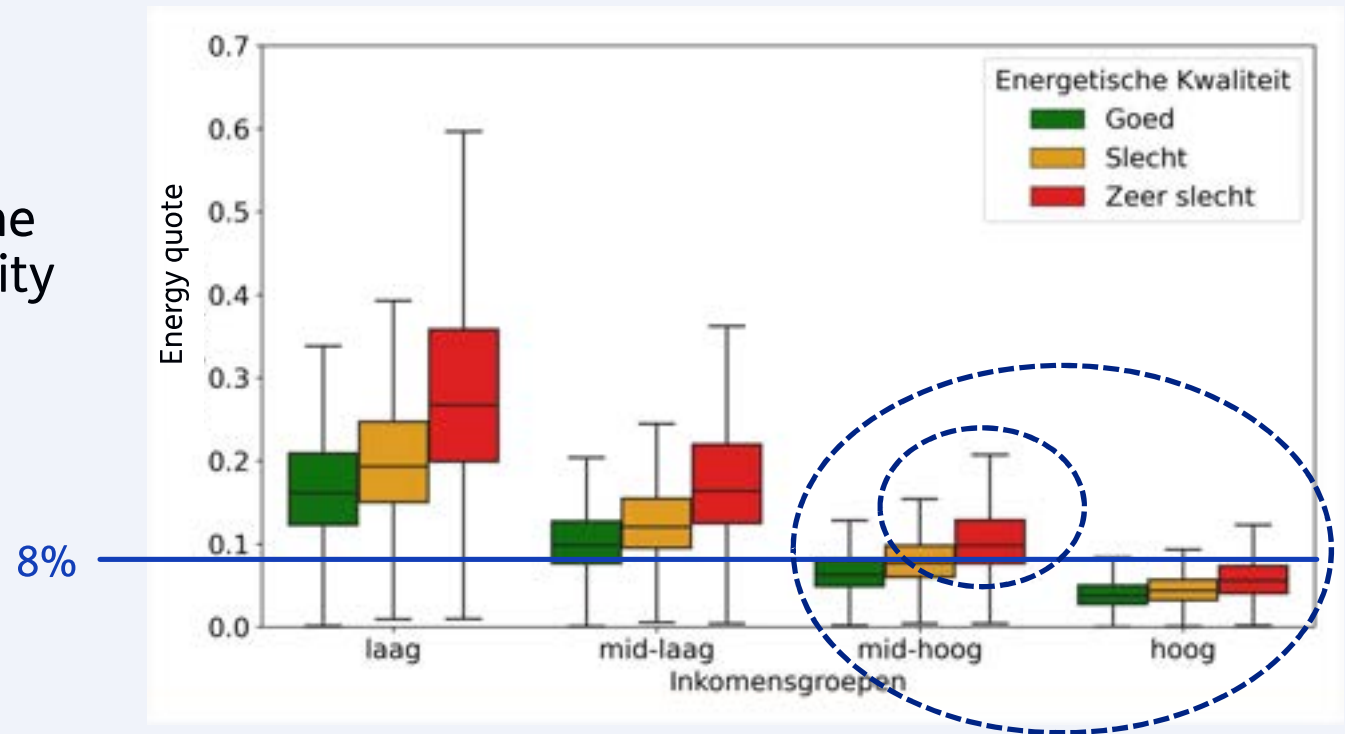
- EQ of hh with income > median: 2% to 6%, also in low energy quality house
- EQ of hh with income < median in low energy quality home: 10% to 16%



At high energy price, high income hh still not vulnerable

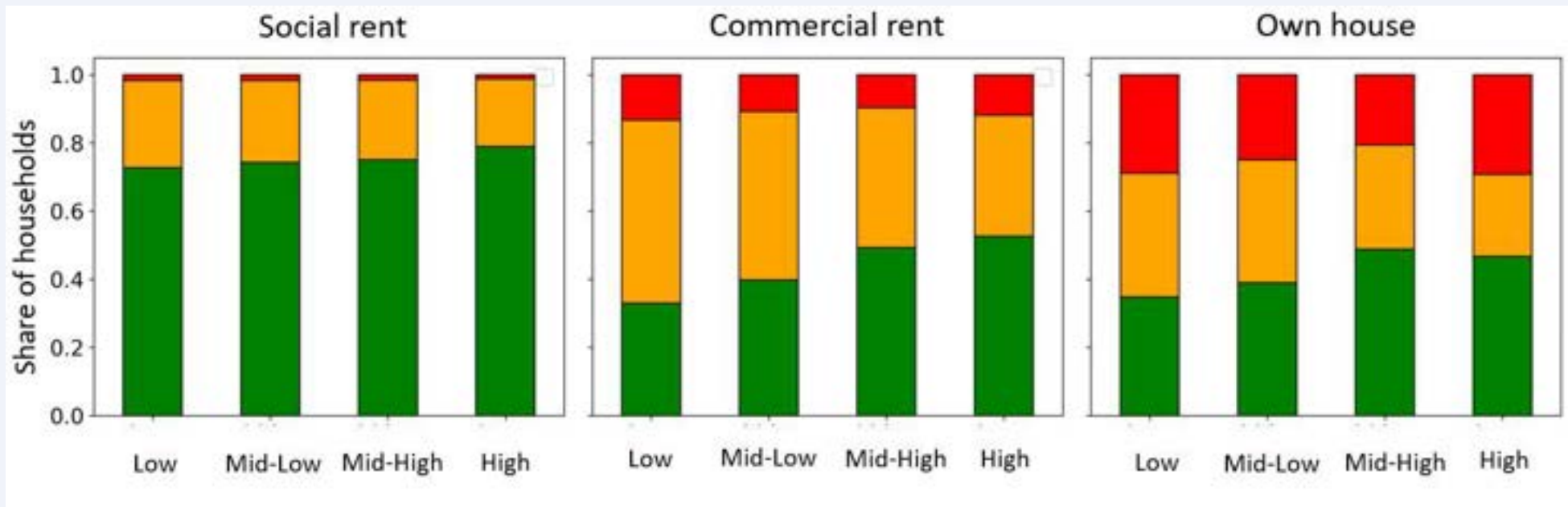
Scenario high energy price (2022 level)

- HH with income > median rarely have high EQ
- Exception: mid-high income hh in very low energy quality house (average EQ = 8 a 10%)
- ~40% of all hh never has high



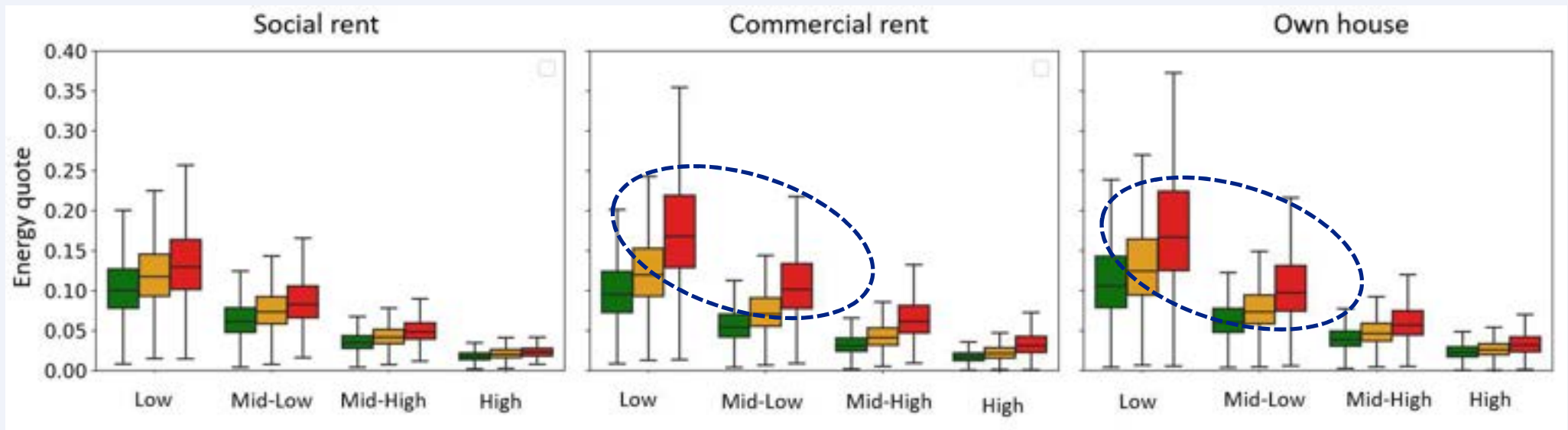
Ownership matters

- Share of (very) low energy quality houses is lowest in social rent sector (!)



Ownership matters

- Highest energy quotes in commercial rental homes and own property (!)
- Despite energy poverty being concentrated in social rent sector (not shown here)

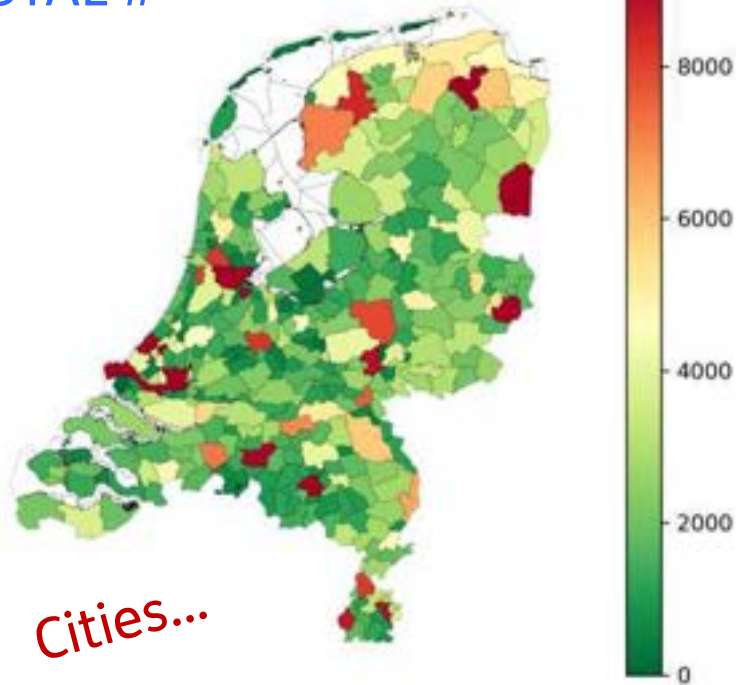


Mid-price scenario

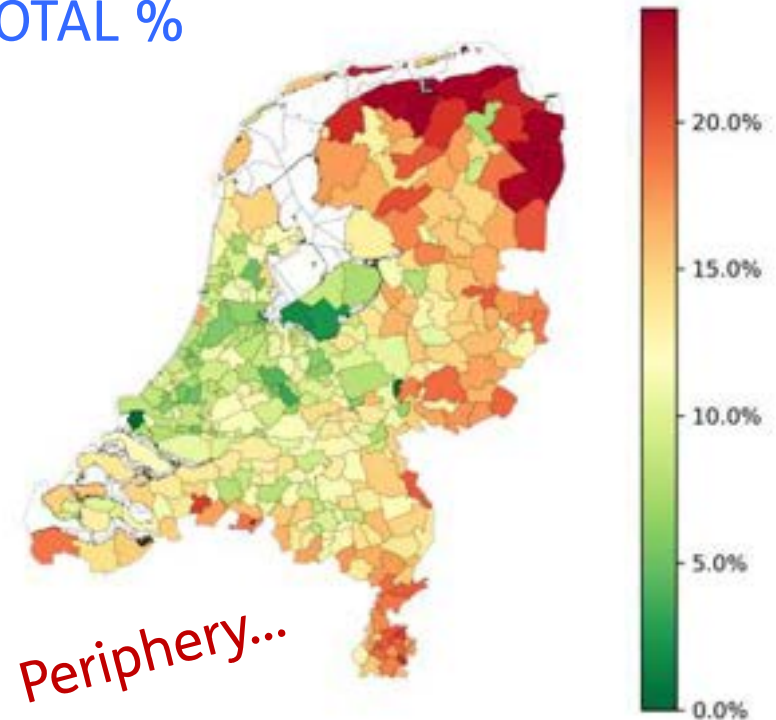
Location – municipality level

HH with i) income < median, ii) (very) low energy quality house, iii) EQ > 8%

TOTAL #



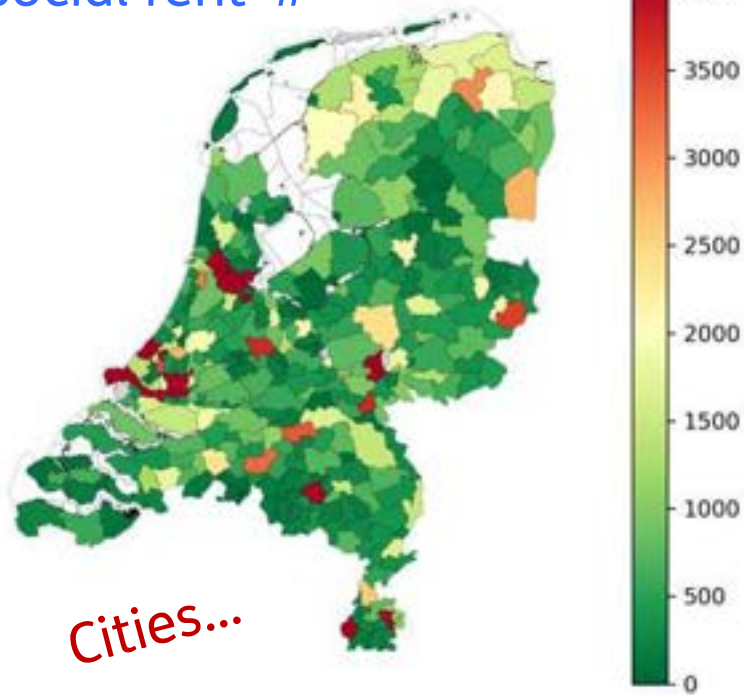
TOTAL %



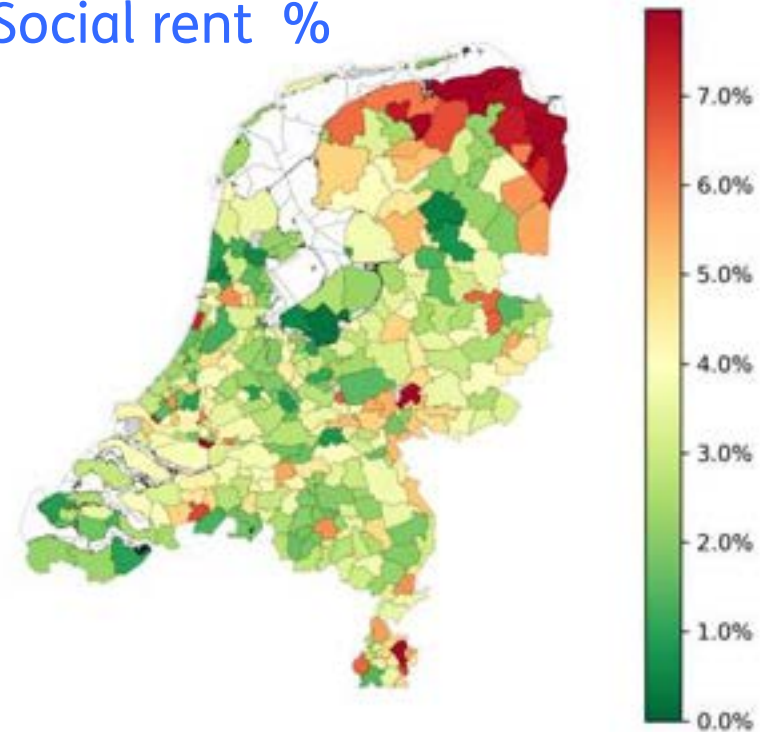
Location – municipality level

HH with i) income < median, ii) (very) low energy quality house, iii) EQ > 8%

Social rent #

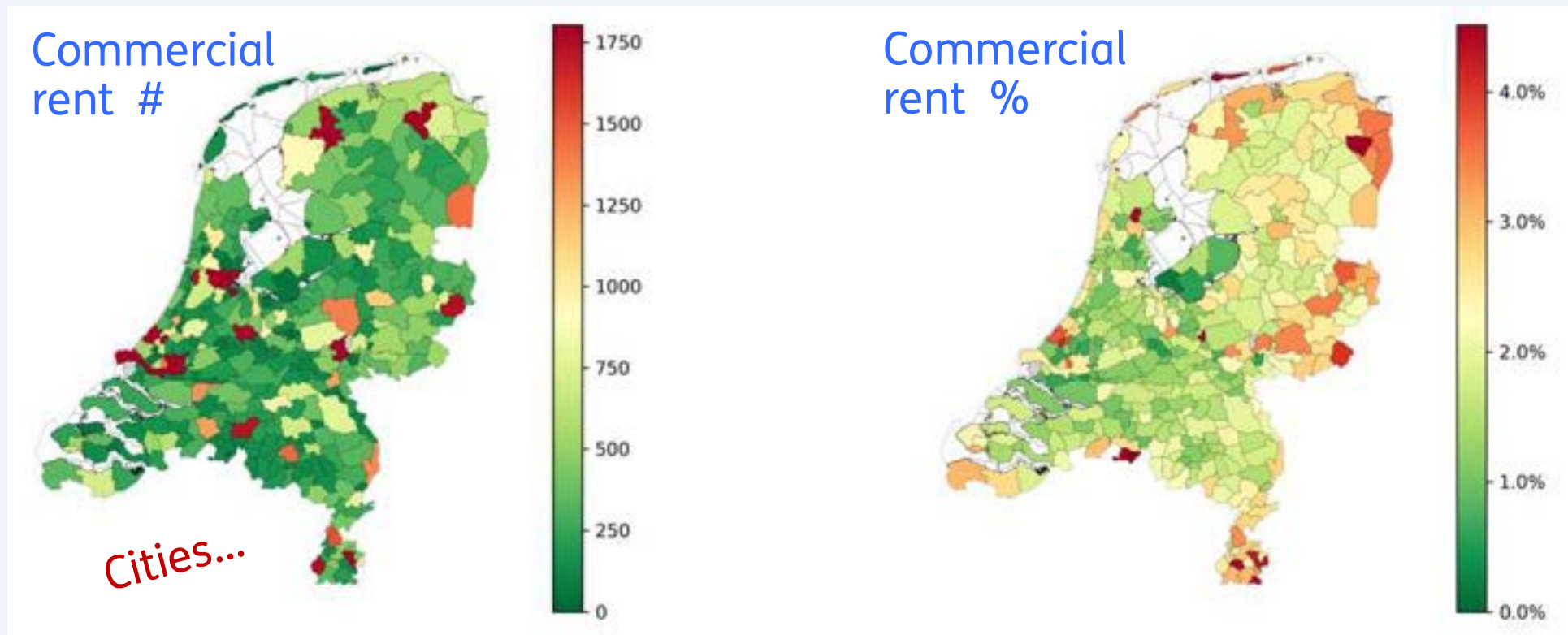


Social rent %



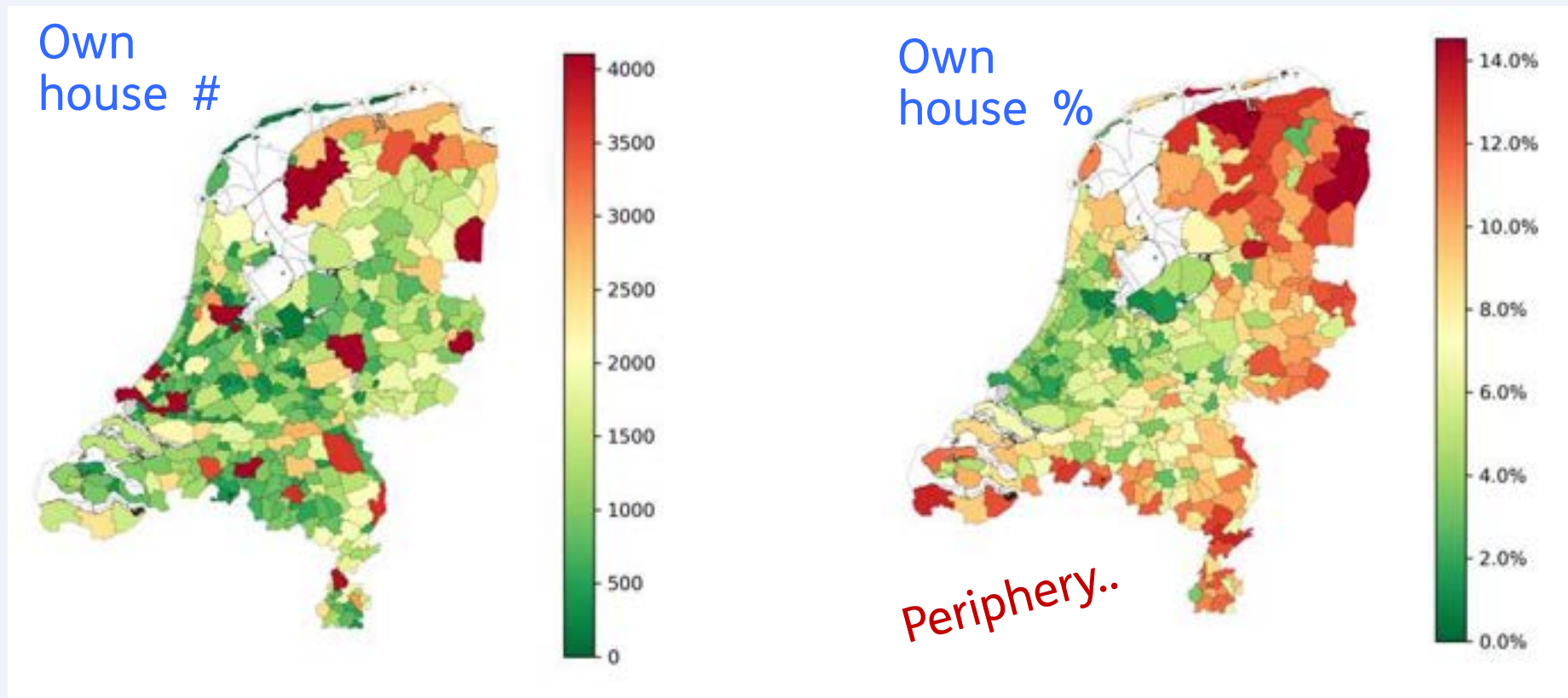
Location – municipality level

HH with i) income < median, ii) (very) low energy quality house, iii) EQ > 8%



Location – municipality level

HH with i) income < median, ii) (very) low energy quality house, iii) EQ > 8%



Policy implications



1. Need for income specific policies

- Weak correlation between income and energy quality home
- House characteristics are problematic selection criteria
 - Energy quality home is legally untenable
 - Construction year is poor proxy of energy quality
- Most high income hh have low energy quote, also at high energy prices
 - High energy prices incentivize home renovation by high income hh
- Many low income hh have high energy quote, some also at low energy prices
- Vulnerable groups are relatively small in size → ‘peak shaving’

2. Home renovation makes a difference

- Especially for lower income households – it reduces energy quote
 - It does however not solve entirely for vulnerability low income hh
- 6% of all hh in NL (~ 420k) have low income & a very low energy quality house
- ~2/3th of them are home owners; of rest majority in commercial rent sector
- These home owners are concentrated in periphery
- One-time investment in home renovation reduces this extreme vulnerability
 - NPV of this investment is, however, not necessarily positive (Mot et al. 2023)

3. Scaling of home renovation proves to be difficult

- Dispersed ownership
- Labour market shortage and high material prices
- Renovation subsidies presume co-finance and organisation talent of home owner
- Limited control of home owners by national government, incl. housing associations
- Standardization of renovation per house class → innovation requires financial guarantees and institutional innovation (collaboration)

Peter Mulder

E p.mulder@tno.nl / p.mulder1@uu.nl

TNO innovation
for life



Aantal huishoudens per groep

- De grootte van deze groepen o.b.v. inkomensgroep & kwaliteit van de woning

Tabel 3. Verdeling huishoudens naar inkomensgroep en energetische woningkwaliteit in percentage en aantallen.

	Energetische kwaliteit woning (LEK)							
Inkomensgroep	Goed	Slecht	Ze er slecht	TOTAAL	Goed	Slecht	Ze er slecht	TOTAAL
laag	9,8%	4,8%	1,1%	15,6%	686.248	336.380	75.252	1.097.880
mid-laag	18,3%	11,3%	4,7%	34,3%	1.288.369	792.030	332.903	2.413.302
mid-hoog	22,8%	13,8%	8,1%	44,7%	1.602.487	971.676	571.323	3.145.486
hoog	2,5%	1,3%	1,5%	5,3%	177.564	92.824	102.829	373.217
TOTAAL	53,4%	31,2%	15,4%	100,0%	3.754.668	2.192.910	1.082.307	7.029.885

Aantal huishoudens per groep

Aantal huishoudens per inkomensgroep & kwaliteit woning

Woningcorporatie woningen

Tabel 4. Verdeling huishoudens naar inkomensgroep en energetische woningkwaliteit per categorie woningeigendom, in percentages en aantallen.

Woningcorporatie								
Inkomensgroep	Energetische kwaliteit woning (LEK)							
	Goed	Slecht	Zeer slecht	TOTAAL	Goed	Slecht	Zeer slecht	TOTAAL
laag	28,7%	10,1%	0,7%	39,5%	588.023	206.357	14.479	808.859
mid-laag	35,5%	11,5%	0,8%	47,8%	726.197	235.201	16.662	978.060
mid-hoog	9,3%	2,9%	0,2%	12,4%	190.081	59.418	4.059	253.558
hoog	0,2%	0,1%	0,0%	0,3%	4.513	1.134	71	5.718
TOTAAL	73,7%	24,5%	1,7%	100,0%	1.508.814	502.110	35.271	2.046.195

Aantal huishoudens per groep

Aantal huishoudens per inkomensgroep & kwaliteit woning

Particuliere verhuurders en andere organisaties dan woco's

Overige verhuurder								
	Energetische kwaliteit woning (LEK)							
Inkomensgroep	Goed	Slecht	Zeer slecht	TOTAAL	Goed	Slecht	Zeer slecht	TOTAAL
laag	6,6%	10,7%	2,7%	20,0%	47.695	77.332	19.257	144.284
mid-laag	16,2%	20,1%	4,4%	40,7%	117.273	145.075	31.907	294.255
mid-hoog	17,6%	14,7%	3,5%	35,8%	127.512	106.136	25.095	258.743
hoog	1,8%	1,2%	0,4%	3,5%	13.258	8.920	3.004	25.182
TOTAAL	42,3%	46,7%	11,0%	100,0%	305.738	337.463	79.263	722.464

Aantal huishoudens per groep

Aantal huishoudens per inkomensgroep & kwaliteit woning

Eigen woning

Eigenaar								
	Energetische kwaliteit woning (LEK)							
Inkomensgroep	Goed	Slecht	Zeer slecht	TOTAAL	Goed	Slecht	Zeer slecht	TOTAAL
laag	1,2%	1,2%	1,0%	3,3%	49.393	51.376	41.018	141.787
mid-laag	10,4%	9,6%	6,7%	26,7%	442.153	409.425	283.278	1.134.856
mid-hoog	30,2%	18,9%	12,7%	61,9%	1.282.109	804.361	541.193	2.627.663
hoog	3,8%	1,9%	2,3%	8,0%	159.523	82.587	99.662	341.772
TOTAAL	45,5%	31,7%	22,7%	100,0%	1.933.178	1.347.749	965.151	4.246.078