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Beyond the label

Using Estimates of Housing Energy Efficiency from
Administrative Microdata to Measure Underconsumption
and Energy Poverty

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September 25, 2025

Beyond the label – contents

1. Why?
2. How we do it
3. What do we do
4. Conclusion



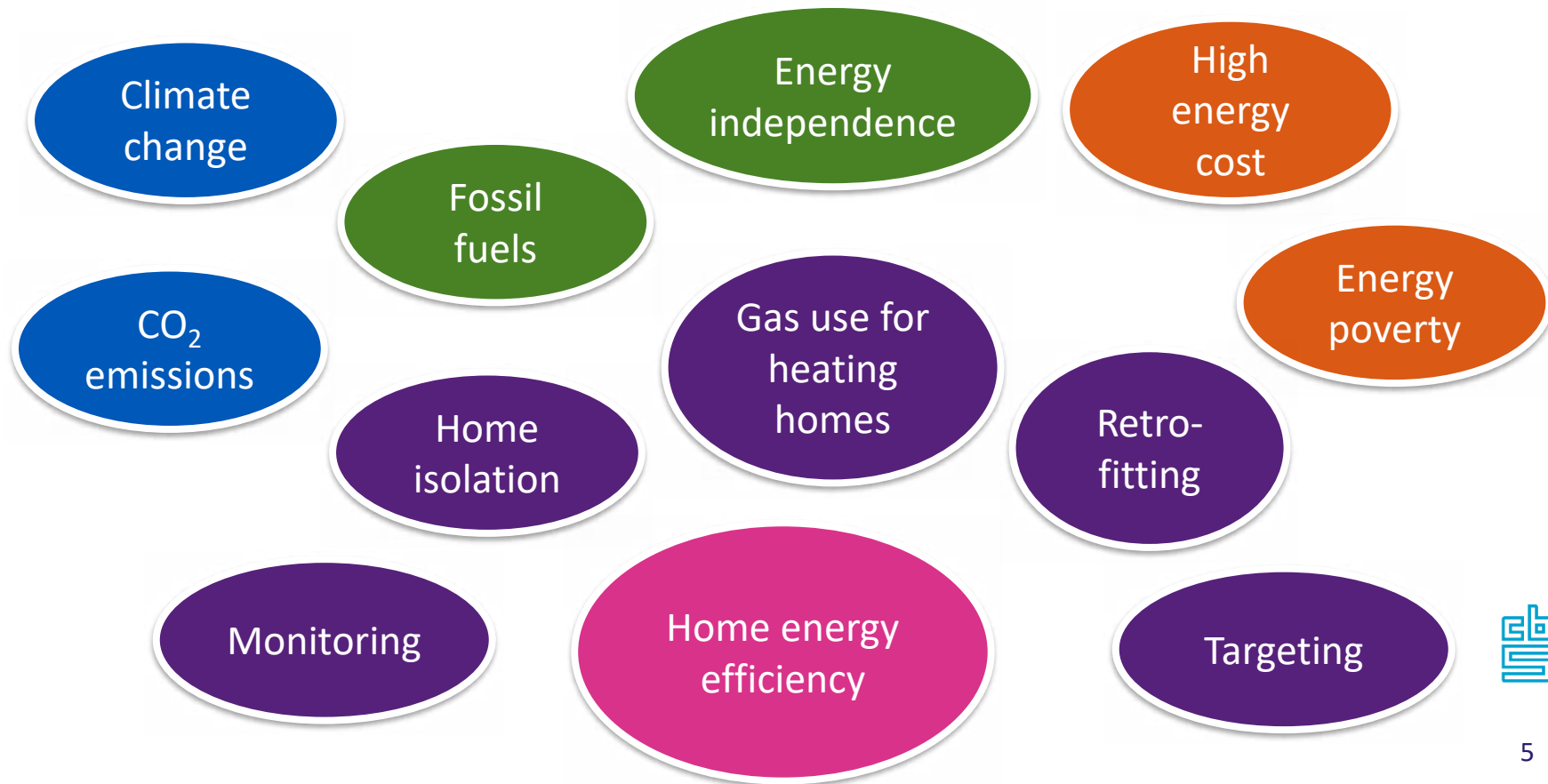
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1. Why?

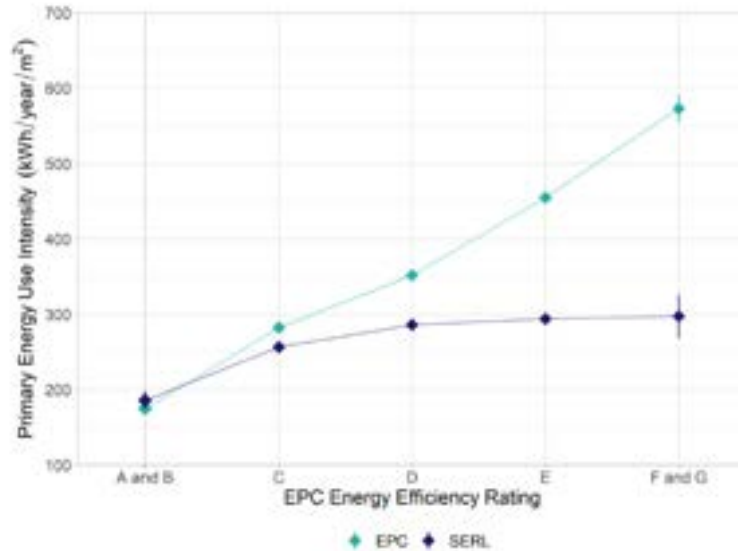


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Why measure housing efficiency?



Energy Performance Certificates (EPC): poor predictor of energy use



Few et. al. 2023

Brom et. al. 2018

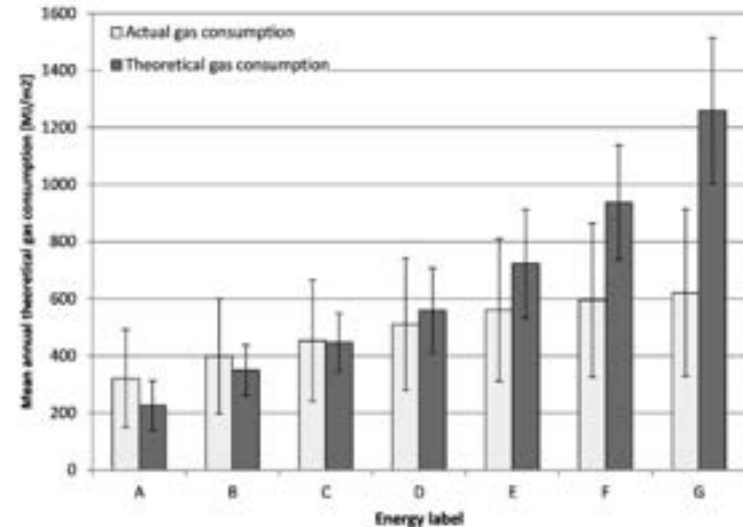


Figure 1. Comparison of actual versus theoretical gas consumption.



Why EPC's relate poorly to energy use

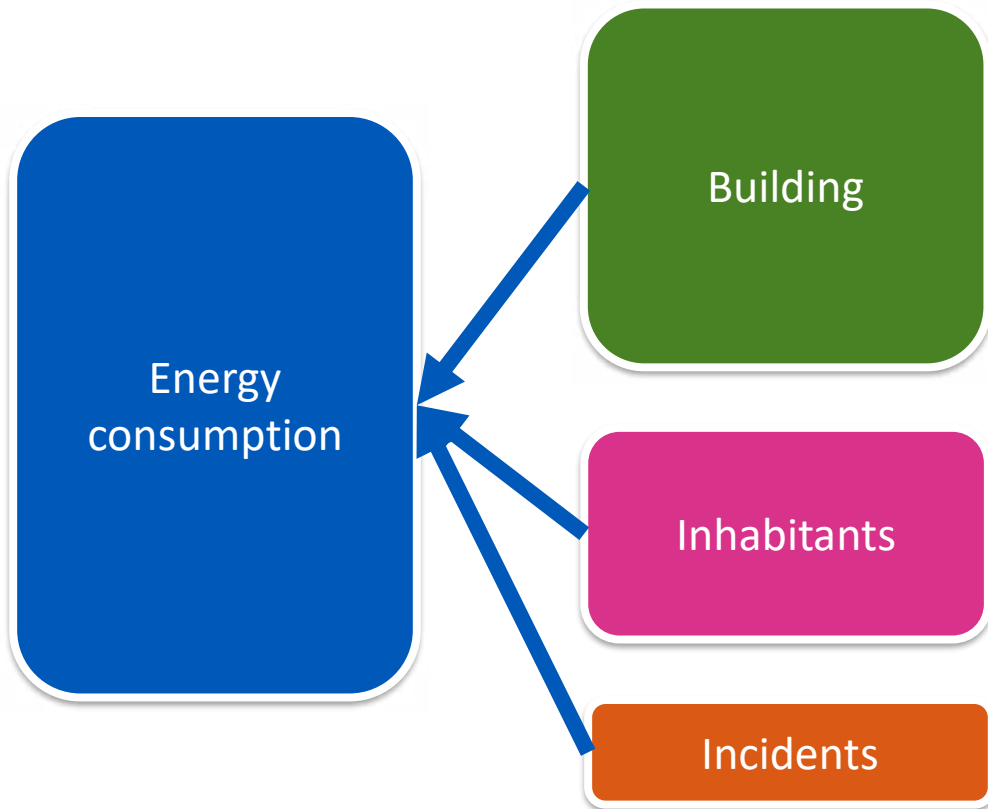
Several (possible) reasons:

1. Outdated
2. 'Rebound'-effect → Little evidence?
3. Faulty assumptions
4. Weaknesses in model
5. Inadequate measurement

Plus: often *no* EPC label (39% in The Netherlands 2024)



Why not use data on energy consumption?

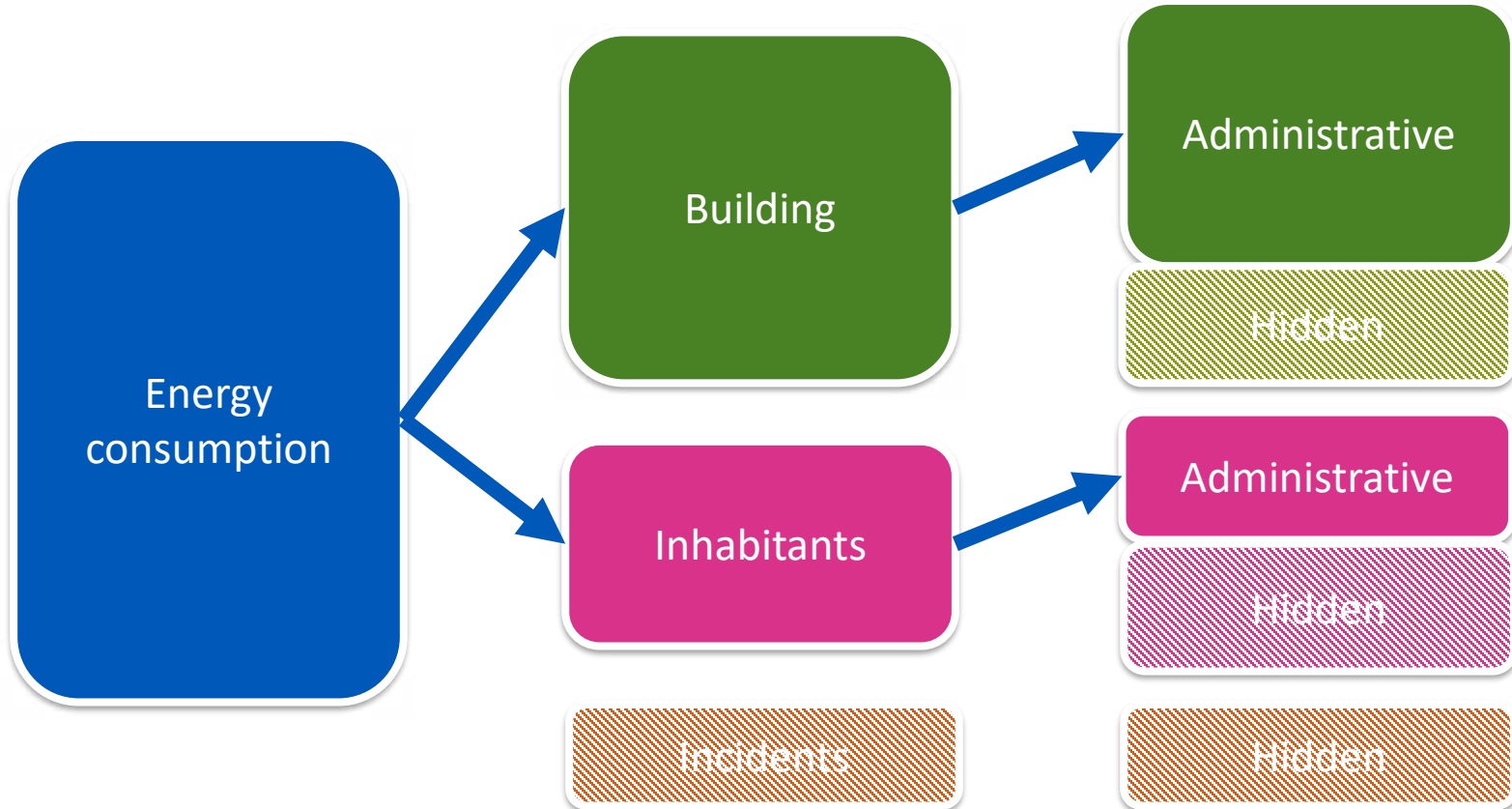


2. How we do it?



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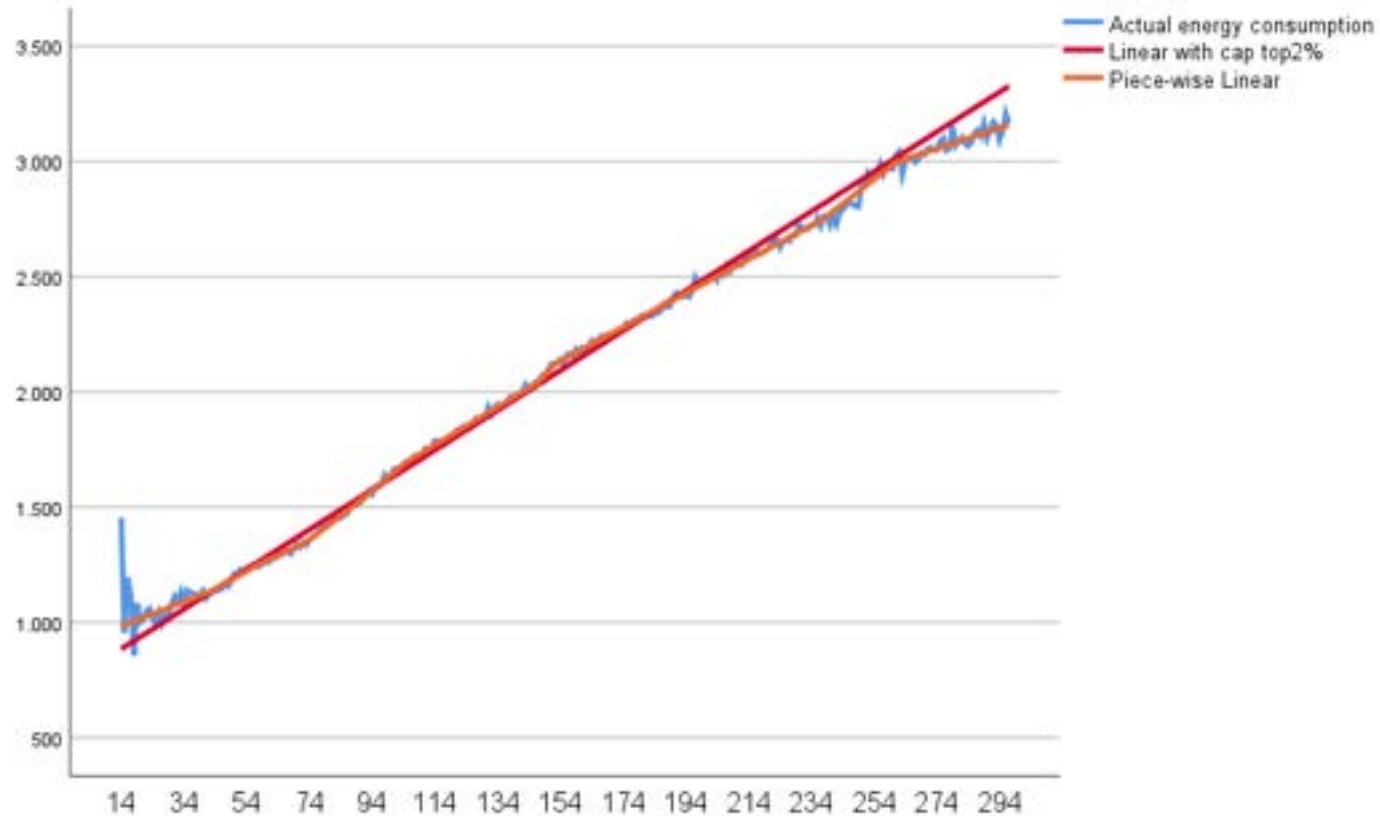
Estimate a model using administrative data



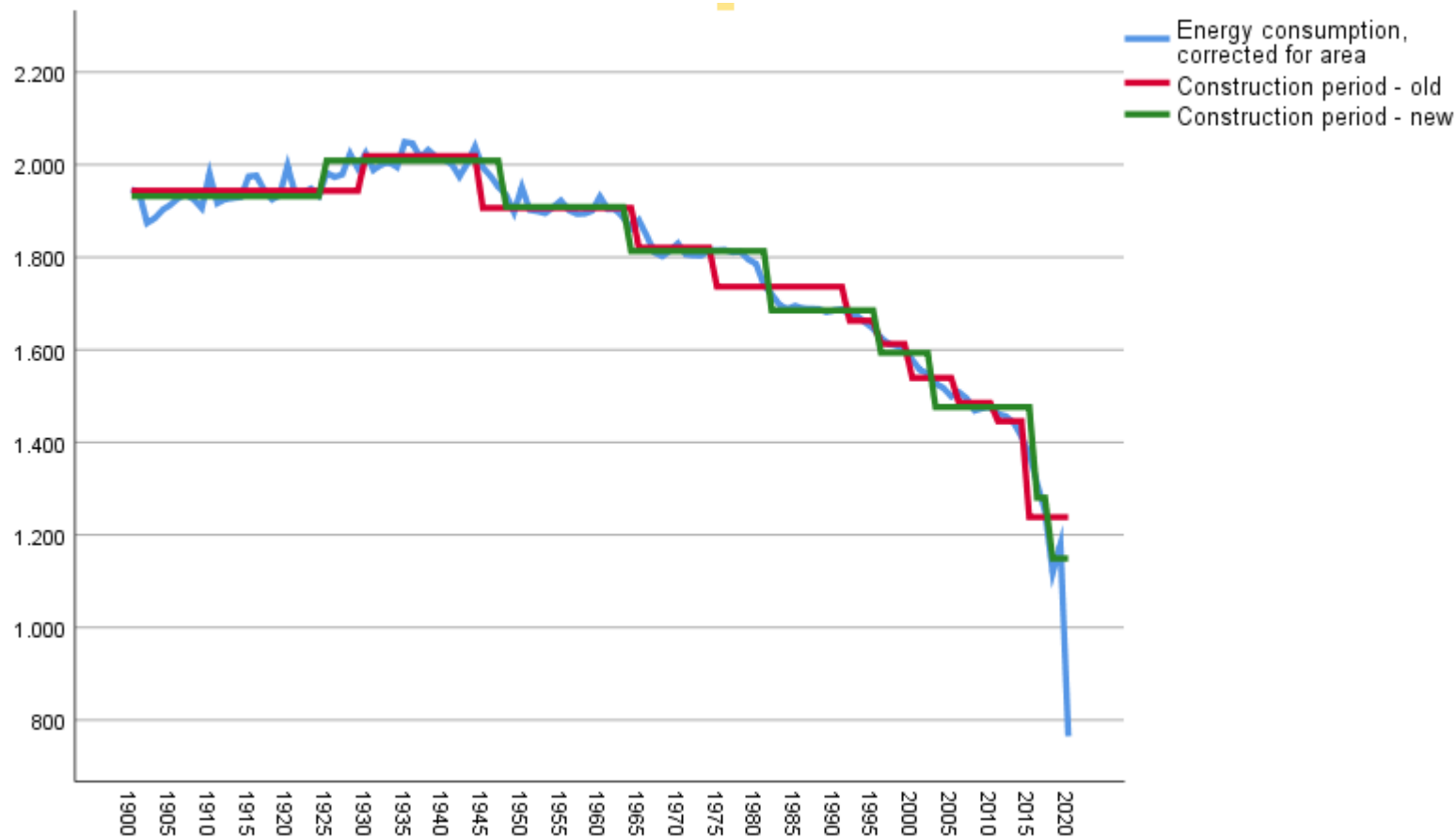
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From administrative data to model – 2



From administrative data to model – 3



Final model – variables

EnergyConsumption ~

Surface (piece-wise linear)

SolarPanels (yes/no)

BuildType (categories)

BuildYear (categories)

EPCLabel

HeatSource

[several interactions]

$R^2=51\%$

People (categories)

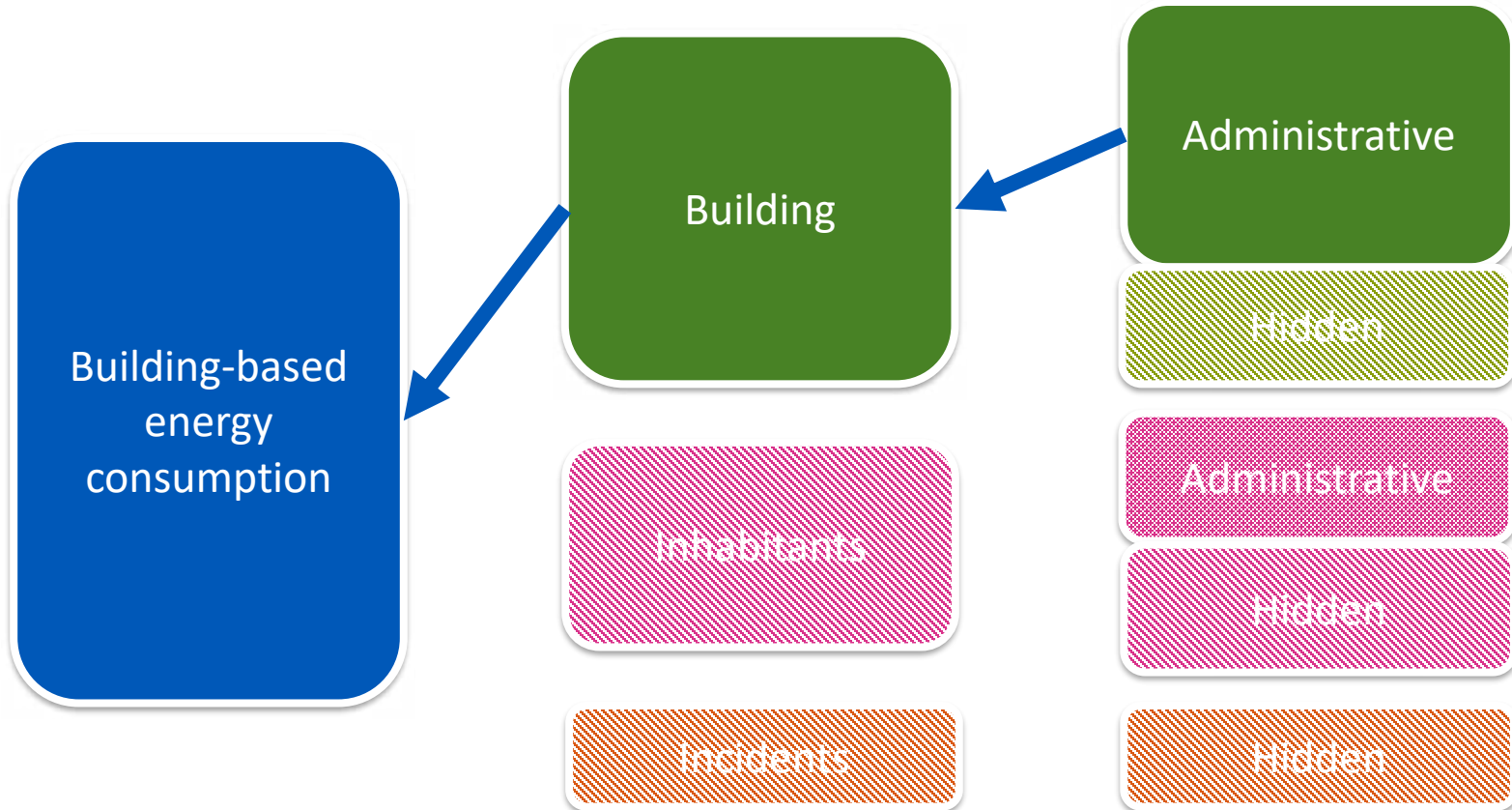
Income (categories)

[several interactions]

$R^2=+7\%$



Predict consumption from adm. building data



Final model – use

EnergyQuality =

$B_1 \cdot \text{Surface (piece-wise linear)}$

$B_2 \cdot \text{SolarPanels (yes/no)}$

$B_3 \cdot \text{BuildType (categories)}$

$B_4 \cdot \text{BuildYear (categories)}$

$B_5 \cdot \text{EPCLabel}$

$B_6 \cdot \text{HeatSource}$

$B_7 \cdot [\text{several interactions}]$

$B_8 \cdot \text{People}=2$

$B_9 \cdot \text{Income}=\text{median}$

$B_{10} \cdot [\text{several interactions}]$



3. What do we do



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Using estimated energy quality of houses

Useful for several purposes:

- a) **Energy poverty** indicator
- b) **Monitoring** housing stock
- c) Detection of **over-/underconsumption**
- d) Potential for retrofitting
- e) ...



a) Energy poverty – 1

Indicatoren energiearmoede filters

Betaalbaarheid en huiskwaliteit

Laag inkomen met of hoge energierekening
of een woning met een lage energetische
kwaliteit

Betaalbaarheid

Laag inkomen, hoge energierekening

Huiskwaliteit

Laag inkomen, lage energetische kwaliteit

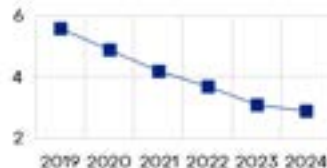
Laag inkomen, zeer lage energetische
kwaliteit

Mogelijkheid tot verduurzamen

Lage energetische kwaliteit woning, weinig
investeringsmogelijkheden

Zeer lage energetische kwaliteit woning,
weinig investeringsmogelijkheden

Landelijk gemiddelde %: Laag inkomen, lage
energetische kwaliteit



2019 2020 2021 2022 **2023** 2024

Gemeenten Provincies



0.5% 13.5%

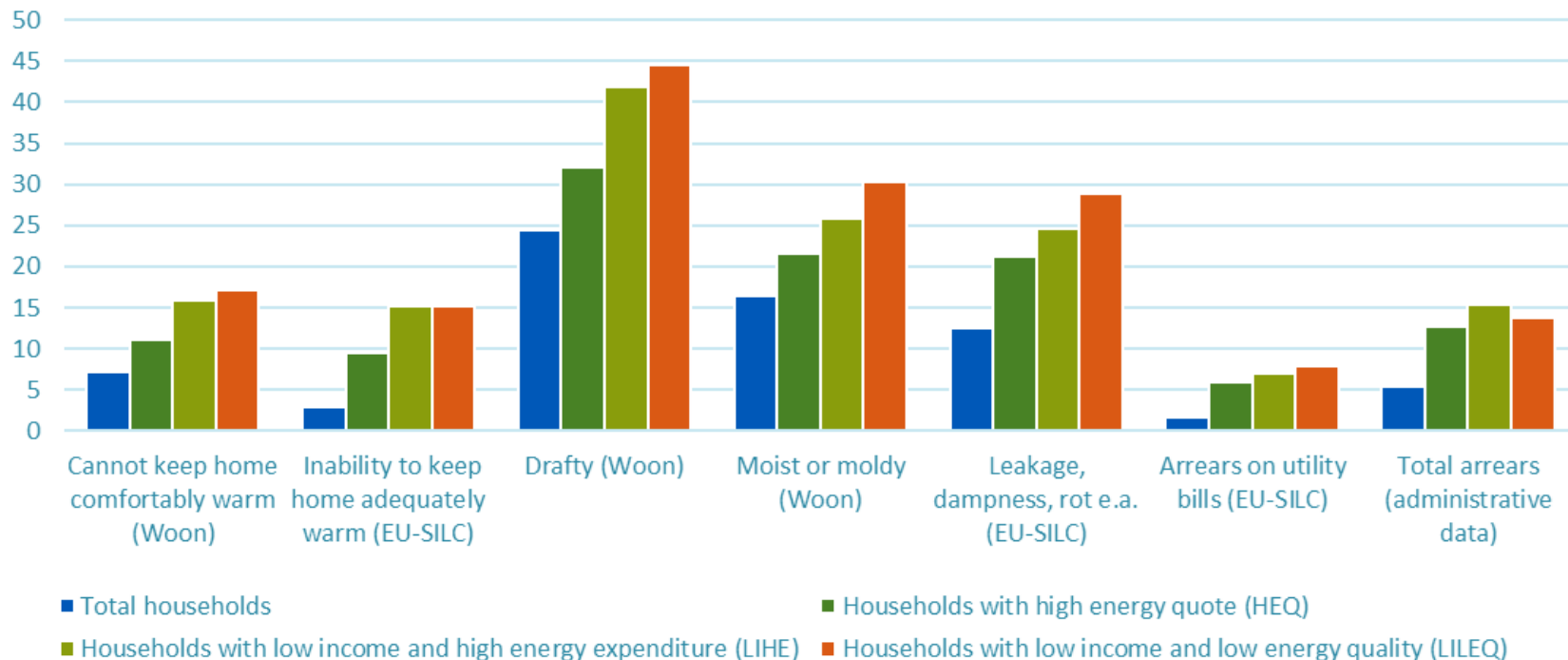
* Groepen die minder dan 10 huishoudens bevatten zijn wegens privacy gerelateerde regels verborgen

a) Energy poverty – 2

Administrative indicators	Survey-based indicators
- High share of energy in total consumption - Low income, high energy cost - Low income, poor EPC label	- Can keep home adequately warm - Arrears on utility bills - Moisture, mold or draught in home
Total population	Small subset
Objective	Subjective
Hidden energy poverty is missed	Detect hidden poverty (<i>can</i> keep warm)
No insight: house or behavior?	Insight in underlying reasons



a) Energy poverty – 3



b) Monitoring housing stock – 1

Comparison to EPC label: prediction of consumption

Energy efficiency indicator	Model specification	Degrees of freedom	R ²
EPC label (in 8 categories: A-G, and 'No label')	EnergyCost = Label + Label * Area	15	0,403
Estimated energy efficiency score (scale)	EnergyCost = EEScore + EEScore * Area	2	0,515
Estimated energy efficiency score (in 8 equal categories)	EnergyCost = EEScore_cat + EEScore_cat * Area	15	0,480



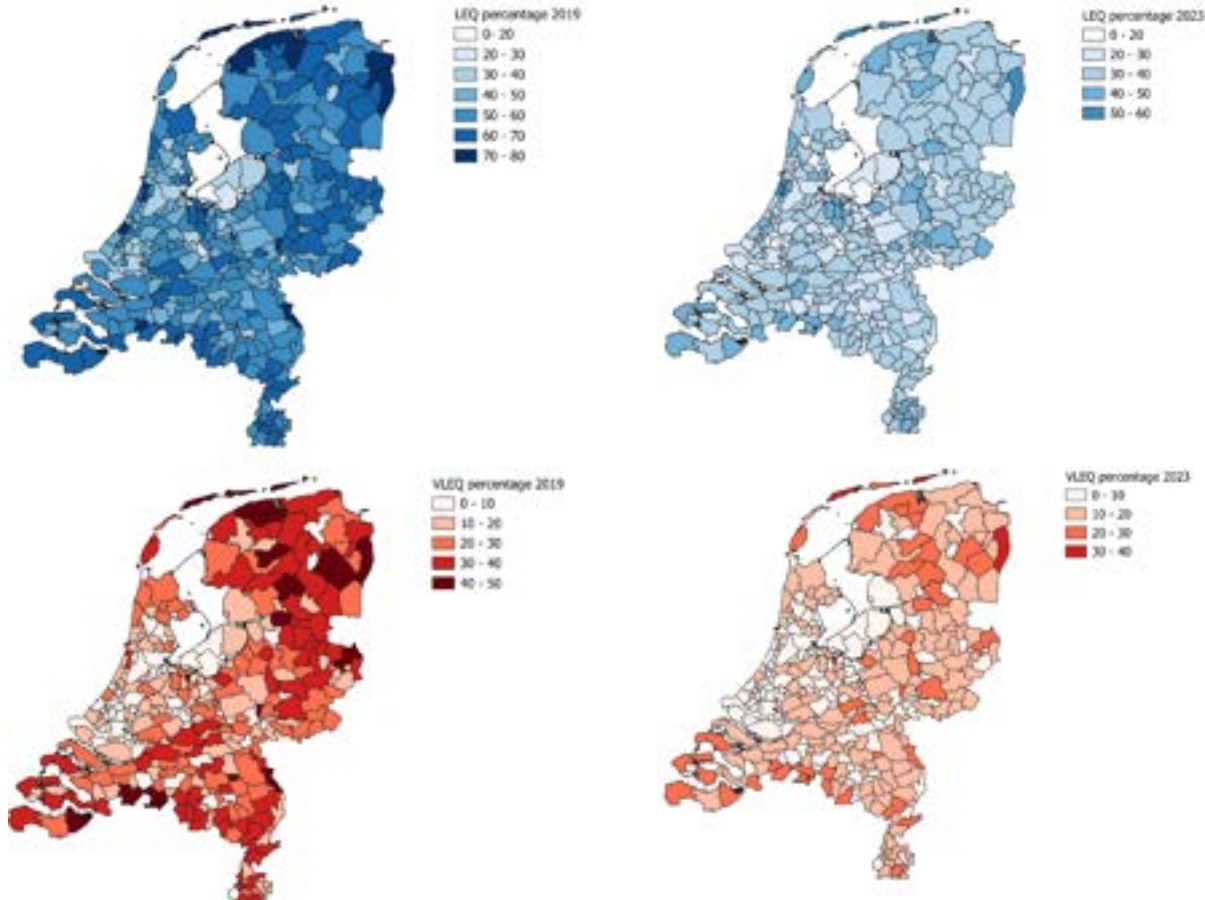
b) Monitoring housing stock – 2

Comparison to EPC label: differences

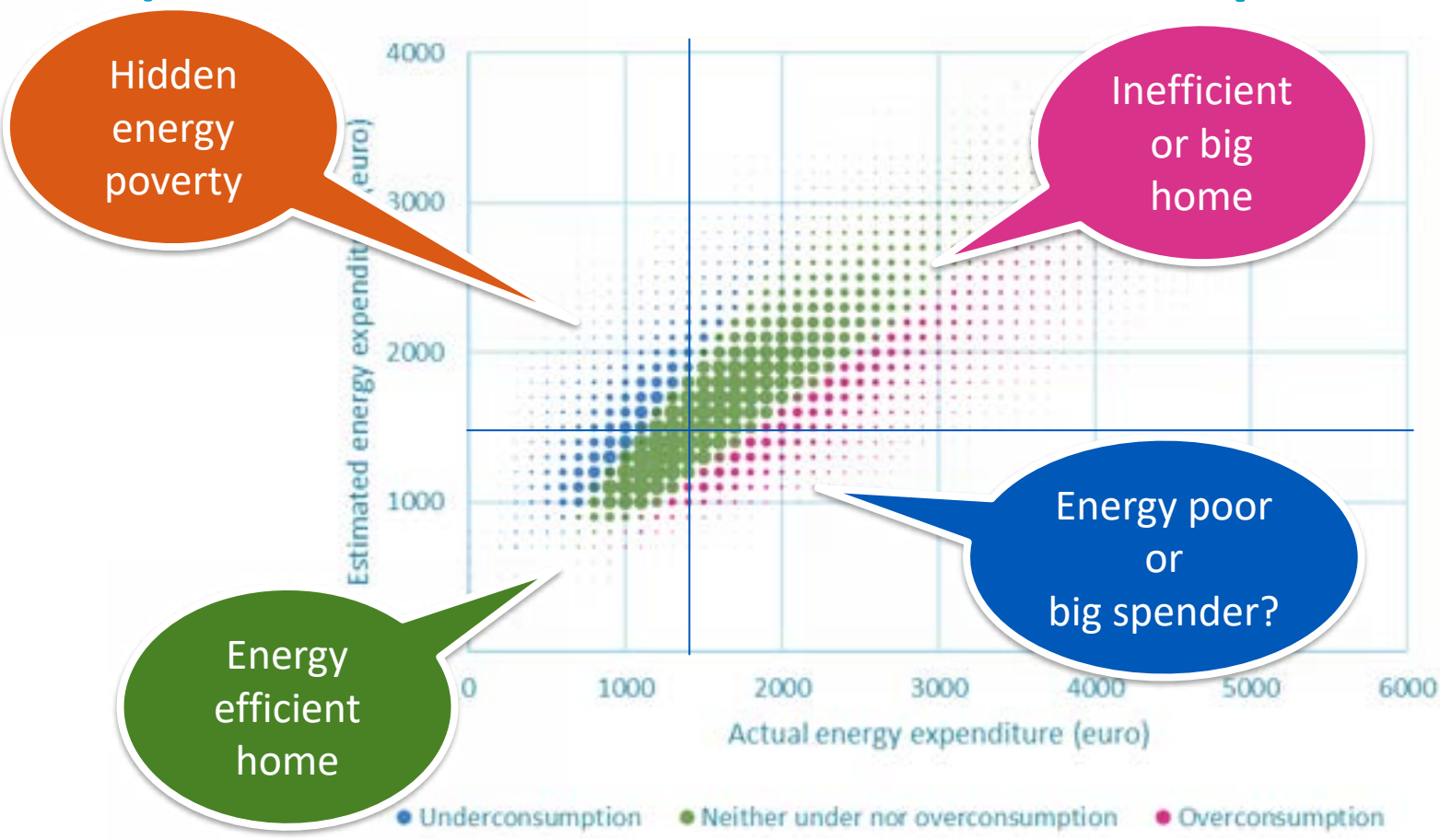
Model-based efficiency score (quantiles)	Share of houses in the row with a certain EPC energy label (%)							
	A	B	C	D	E	F	G	No label
Total housing stock	8	8	14	8	5	3	2	53
Non-Low Energy Quality (non-LEQ)	15	13	22	8	3	1	1	36
Low Energy Quality (LEQ)	1	2	6	9	6	4	3	69
Very Low Energy Quality (VLEQ)	0	1	2	2	2	3	4	87



b) Monitoring housing stock – 3



c) Detection of over-/underconsumption



4. Conclusion



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Summary

- **Home energy efficiency is important** for climate, energy and income related policy
- Energy Performance Certificates (**EPC**) are **mediocre** indicators of energy efficiency
- **Modelled energy consumption improves** upon EPC's as indicator of home energy efficiency
- **Low income and low energy efficiency** is a great indicator for energy poverty
- **More possibilities** lie ahead!



Contribution – 1

We build upon the work of others:

- Modelling energy consumption → o.a. Karpinska & Smiech 2020
- Use modelled consumption instead of EPC's → o.a. Van den Wijngaard & Van Polen 2020
- Home efficiency as component of energy poverty → o.a. Low Income Low Energy Efficiency (ONS 2022)



Contribution – 2

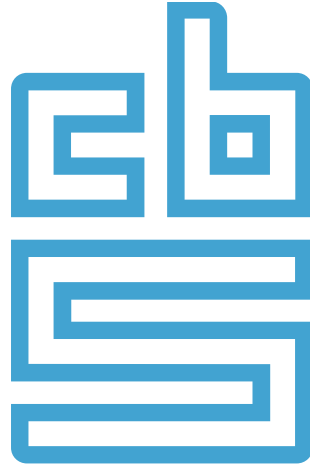
Combine:

- **Administrative** data (instead of EU-SILC)
- **Estimated** energy use (instead of EPC)

To get:

- Better **energy efficiency indicator** for **all houses**
- Better **energy poverty indicator** for **all households** (almost)
- Target **hidden** energy poverty and **overconsumption**





Facts that matter