Predicting energy consumption and savings in the housing stock

TU Delft

UNIVERSITÉ DE GENÈVE

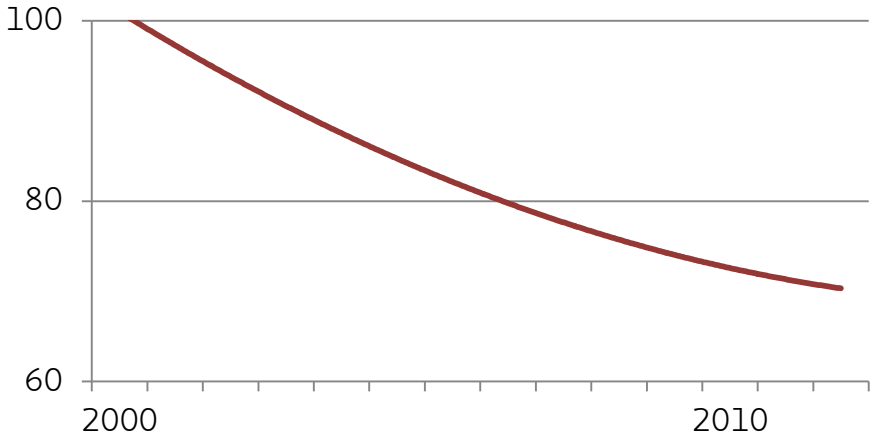
Daša Majcen

PostDoc in the Group of Energy Efficiency

Institute for Environmental Sciences and Forel Institute

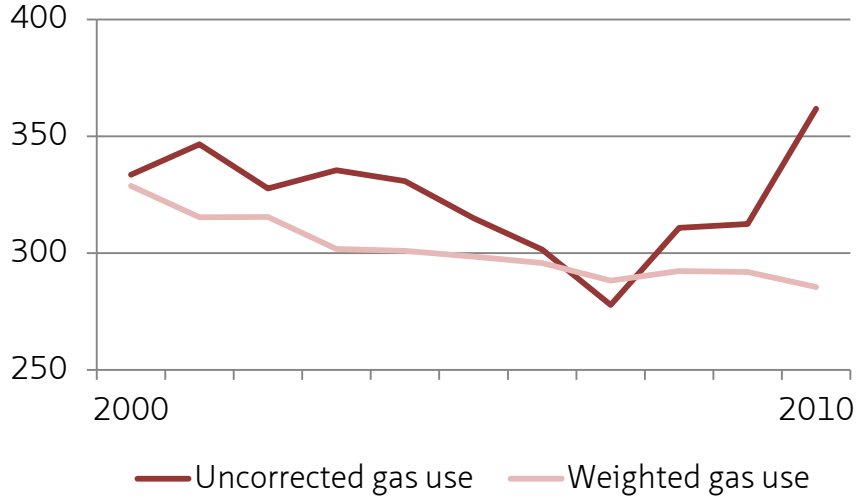
Energy efficiency of the Dutch housing stock

Energy efficiency index of household space heating, The Netherlands



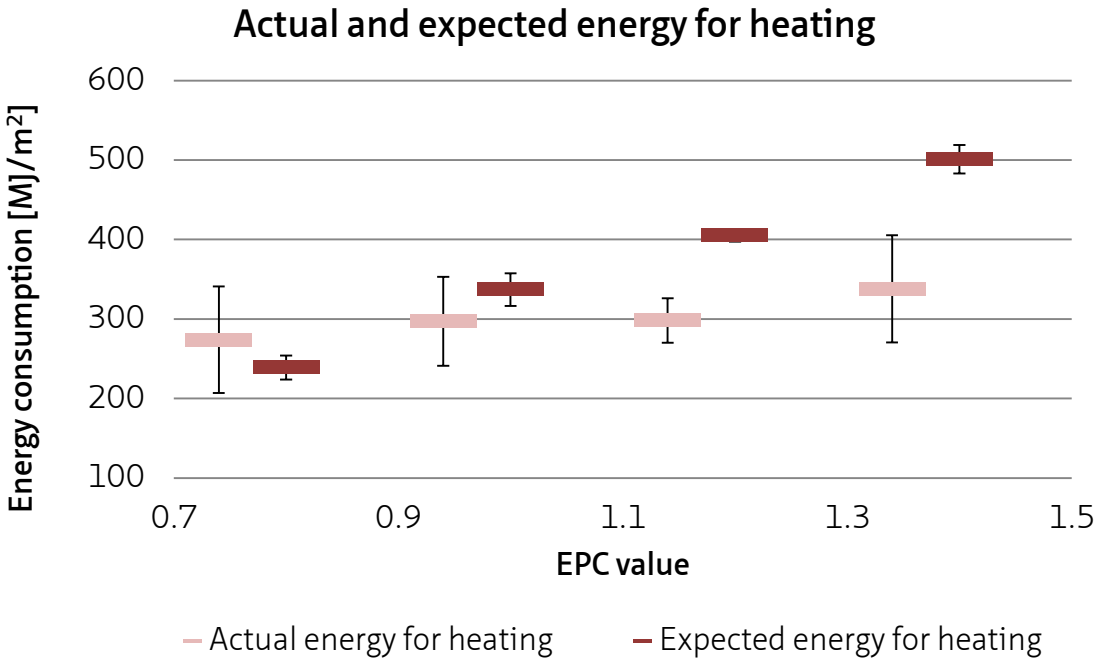
ODYSSEE-MURE (Netherlands), Intelligent Energy Europe programme, 2012

Total gas consumption of Dutch households [PJ]



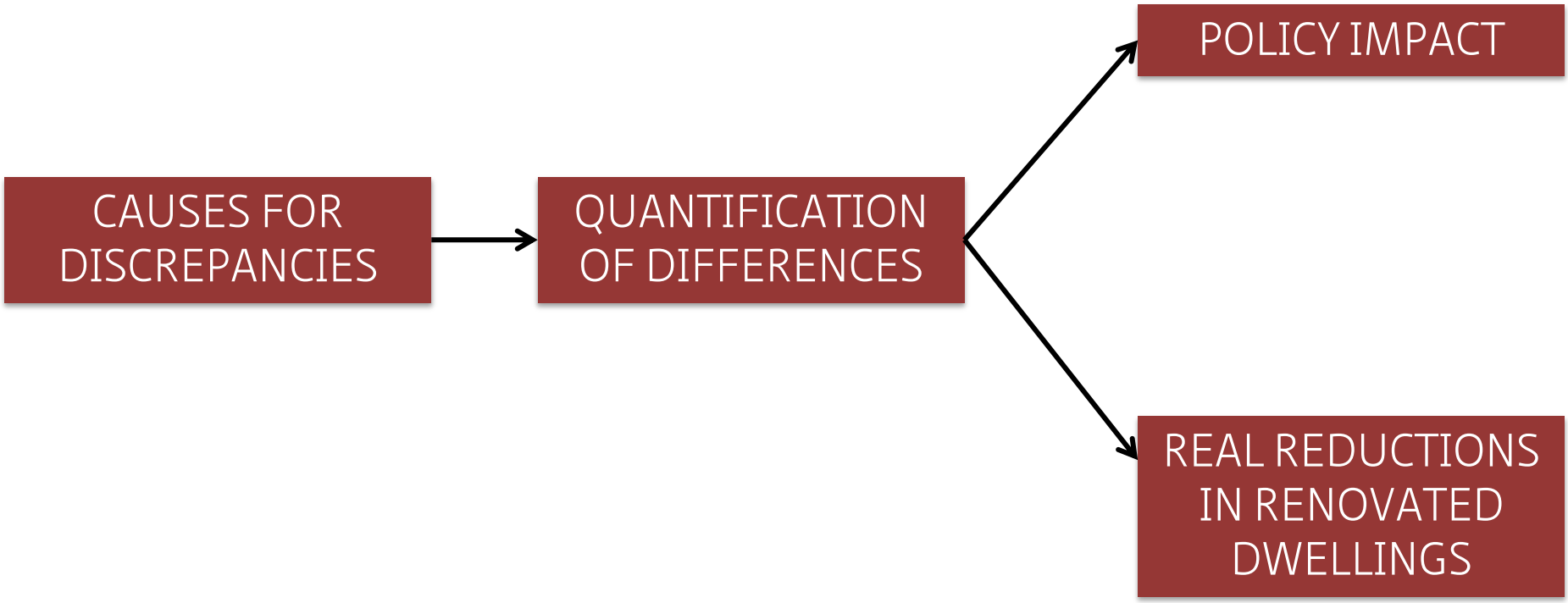
Statistics Netherlands, 2012

Drivers



Olivia Guerra Santin, 2010

What are the characteristics and consequences of the discrepancies between actual and theoretical heating energy use in Dutch dwellings?



Data

	1.	2.	3.	Reference
Source	Ministry	Amsterdam Municipality	Social housing corporations	Nationwide survey
Size (raw)	194000	460	644000 and 82000	4000
	2011/12	2014	2015	2012

Methods

Label data - basic

Label and theoretical energy use

Installation, dwelling type, address, floor area, year of construction

Label data – enriched

Basic but historical data

Including U values, ventilation and domestic hot water appliance

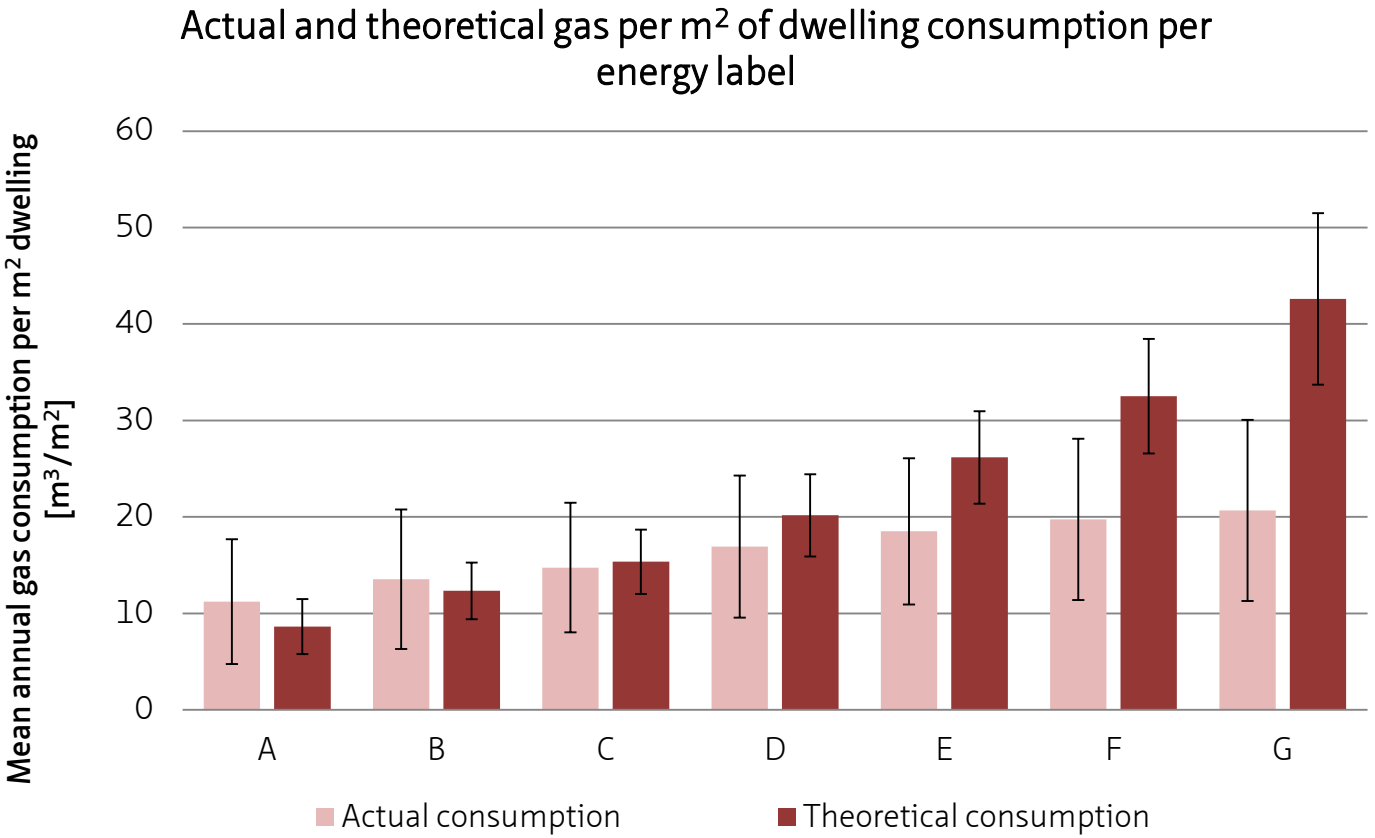
Linking to actual energy data (address)

Data standardisation

Data filtering

Statistical analysis

Discrepancies: The performance gap



Policy consequences

Targets for building sector

1. EC Action Plan for Energy Efficiency 2006 - **27%** reduction by 2020
2. The SERPEC-CC report - **19%** below 2005 emissions by 2020
3. EU project IDEAL – cost effective savings of **10%** by 2020
4. **National target <20-30%** reduction by improving the dwellings by 2 label steps

Realisation based on current policy scenario

1. Theoretical baseline – we reach 30%
2. Actual baseline – we reach 13%

Consequences for renovated dwellings

	Actual savings per year [m^3]	Theoretical savings per year [m^3]
G to F	133	508
G to E	153	846
G to D	215	1415
G to C	301	1742
G to B	354	1871
G to A	446	2075
G to A	446	2075
F to A	510	1688
E to A	392	1107
D to A	318	718
C to A	137	310
B to A	129	125

What causes the differences?

SIMPLE REGRESSION AND SENSITIVITY

Building, household and occupant characteristics									
Building characteristics									
Floor area	Age	Energy label	Dwelling type	Installation type	Value	Ownership type	Community	Salary	Free capacity
R^2=42% of variation explained									
R^2=44% of variation explained									

Label	Discrepancy [m^3]	Indoor T [°C]	Insulation [W/m^2K]
A	-232	2.7	0.09
B	-116	1.1	0.08
C	72	-0.5	-0.07
G	1816	-5.6	-6.88*

Conclusions

Large discrepancies

Misleading – for policy makers and actors involved in renovation

Causes – dwelling and behavioural parameters

Methodological improvement is possible

Label methodology

Input parameters

Inspection

Depicting consumption on certificates?

Reduction potential

Encourage use of actual data

Encourage measures that are effective in reality

GAPxPLORE Energy performance gap in existing, new and renovated buildings

Learning from large-scale datasets

Preparation of proposal for research program Energy in Buildings (SFOE):

GAPxPLORE Energy performance gap in existing, new and renovated buildings – Learning from large-scale datasets

- Existing studies based on small samples
  - Some indication of performance gap, not representative

- Lack of studies on a population scale due to a lack of data, now energy certification data:
  - FHNW - GEAK 20.000 certificates (since 2008)
  - SUPSI - Minergie & Energo 5000 certificates (smart meter)
  - Solaragentur – 300 detailed building data from applicants for Solar Price

GAPxPLORE

- Study the usability of the data
- Analyze:
  - value performance gap (VPG, calculated demand vs. actual consumption)
  - savings perf. gap (SPG, the expected vs. achieved energy reductions of renovations)
- Relate findings to case studies and monitoring data
- Model cost-effective improvements of buildings: potential of energy demand reduction of different measures (more efficient appliances, heating and dhw system replacement, envelope improvement etc.)

Thank you!