TNO innovation for life

Effects of deviations from air tightness in the design on the total energy consumption of dwellings

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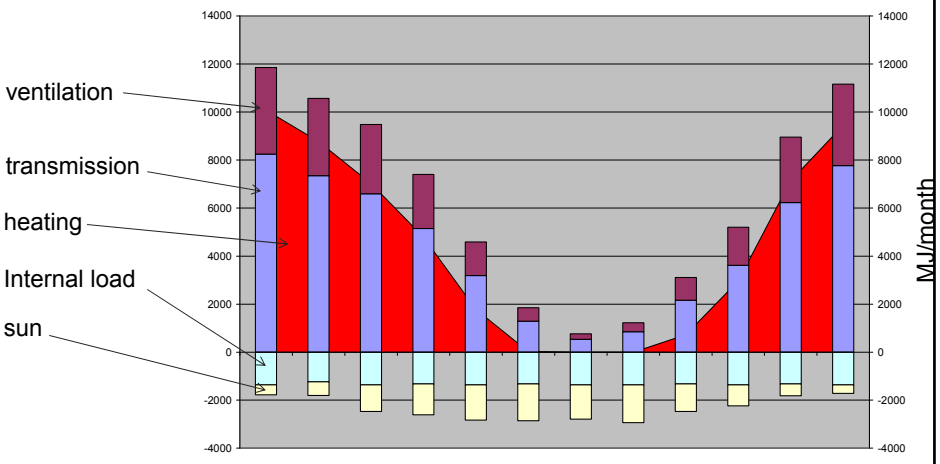
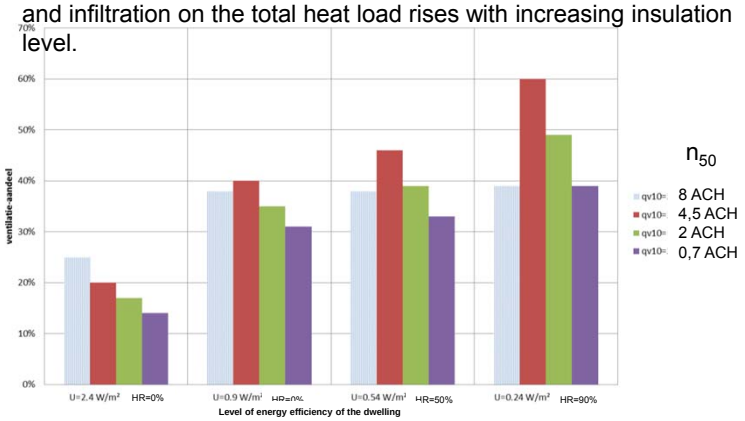
Some theory: heating demand during the season in the Netherlands for an average 1970 dwelling 70% transmission 30% ventilation



Percentage of ventilation and infiltration on heating demand increase with insulation level

- U value walls 2,4 -> 0,24
- Air tightness 8 ACH -> 0,7 ACH n_{50}
- Heatrecovery efficiency 0% -> 90%

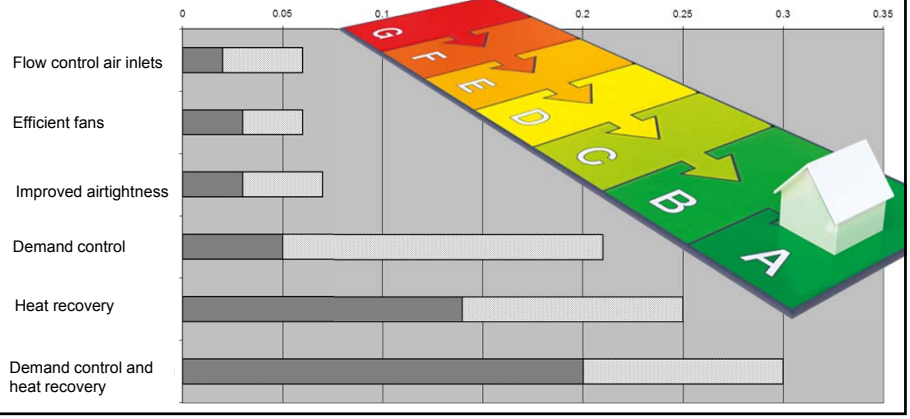
Even with increasing effective heat recovery the percentage of ventilation and infiltration on the total heat load rises with increasing insulation level.



Theory: Effect of air tightness and innovative ventilation systems on the Energy performance (Energy label score)

Effects of different measures of energy saving on the energy demand in the relative amounts of saving on a typical house built in 2000.

Improved air tightness is a popular measure to improve the label score



Energy leap program

Innovation-implementation program "Energiesprong" (Energyleap in Dutch) focuses on the development of marketable propositions for energy neutral (on the meter) buildings which are affordable, profitable for the building industry, provide good living conditions and realize the promised performance characteristics.

Monitoring program Energy leap

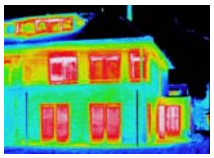
Integral monitoring of demonstration projects is an important part of this program. 300 dwellings will be monitored by:

- Smart meters gas
- Smart meters electricity
- Temperatures living room, sleeping room
- Outdoor climate (through weather stations)
- Questionnaires
- Blowerdoor, infrared, inspections

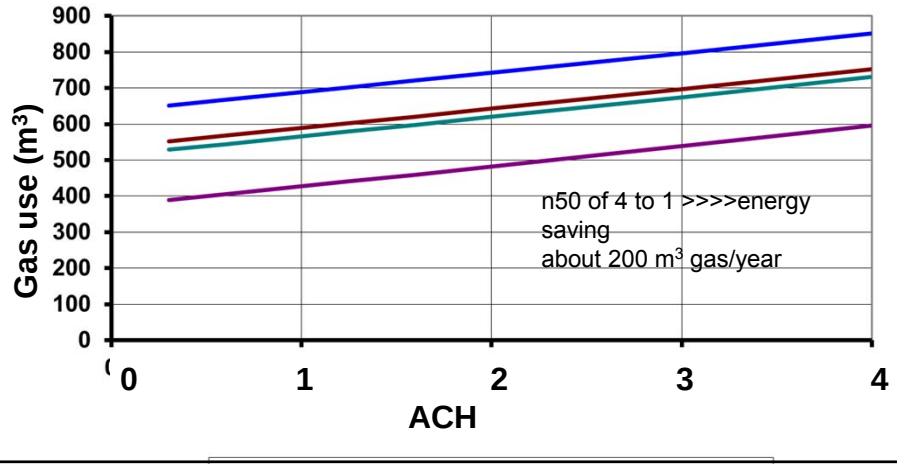
Quality control Energy leap

Bouwtransparant (transparent building method):

1. Initial calculation of energy performance
2. Building inspections on compliance with specialized software inspection tool
3. Blowerdoor and infrared
4. Recalculation of energy performance based on 2. and 3.

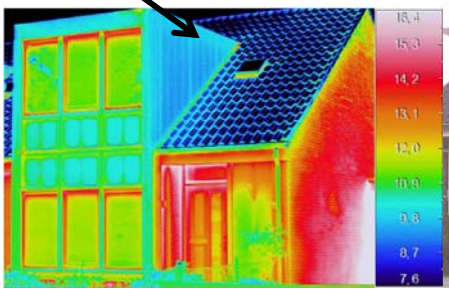



Effect of non compliance of air tightness on energy use



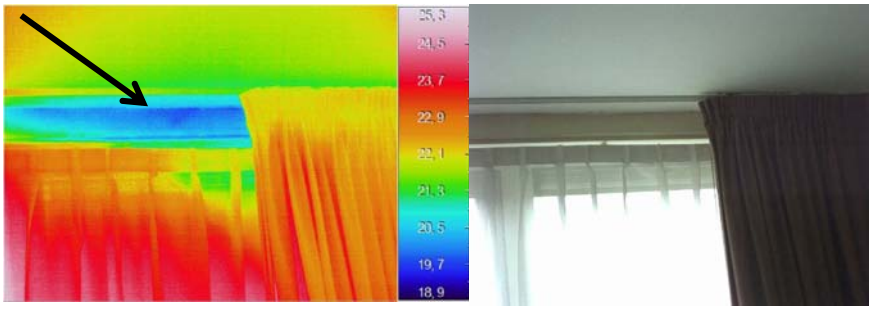
First results monitoring project Biddinghuizen

Infrared photography as indicator for air leakage



Air leakage at the roof

Infrared photography as indicator for air leakages



Air leakage at the connection of the window frame and facade

Blowerdoor and test with smokes

No seals at the door towards unheated storage room

No air leakage at window

Blowerdoor and test with smokes

Air tightness roof window

Air leakage outside

Air leakage inside

Blowerdoor results

Blowerdoor results were about
5-6 ACH where
1-3 ACH could be expected.

Amount of extra gas for space heating depending on use is approximately 50-150 m^3 gas per year.

This must also be seen in perspective with the variations due to use.

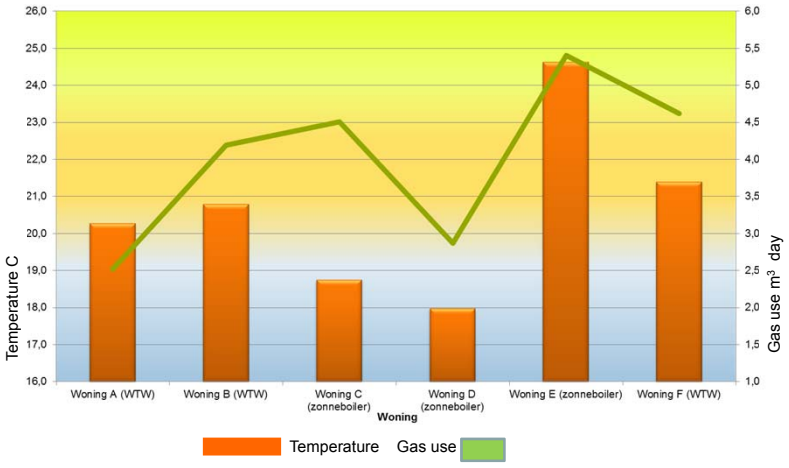
Testing in an early stage when several houses are being renovated can give value input for improvement.

Variation in energy use due to user patterns

Within the project there is much variation between households in:

- Number and type of appliances,
- Room temperature,
- Use of windows and doors,
- Number and age of occupancies.

Effects of user behaviour

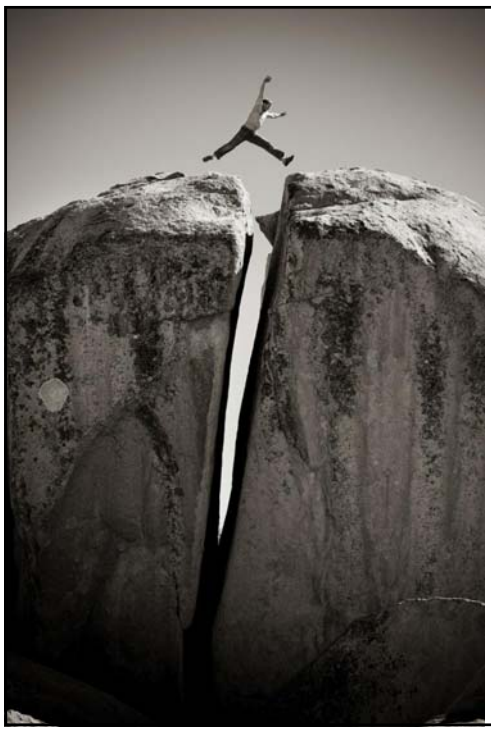


maximum gas use differences in m^3 day ≈ $3m^3$ gas day

Heating season 180 days 540 m^3 gas

Conclusions

- Inspection (tools), infra red photography, early stage blowerdoor can improve the air tightness and quality of the building which can save energy.
- User behavior has strong impact on energy use. Insight in the effects can help design more robust HVAC and buildings systems.



A leap in energy savings can be made

Thanks