

Interactions of air tightness with ventilation systems and implications on energy use

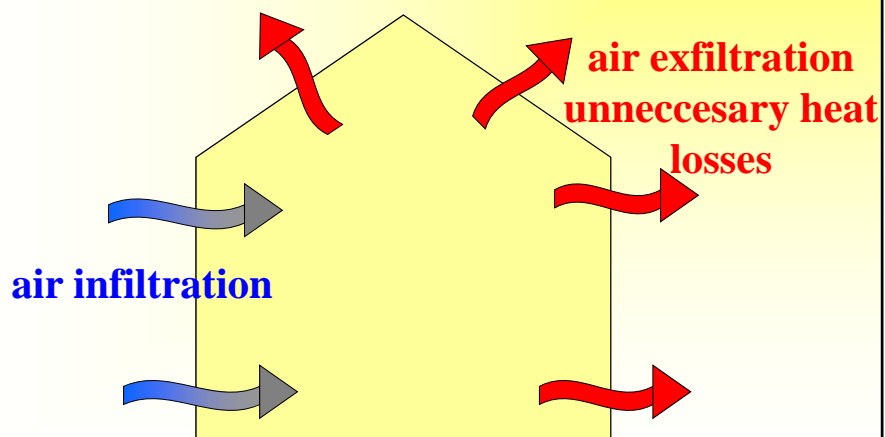


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Unintended flows due to air leakage



Ventilation system
natural supply
and
mechanical
exhaust



Intended flows extract ventilation systems

air extraction from wetrooms
ducts and air terminal devices



air supply in façade
purpose provided inlets

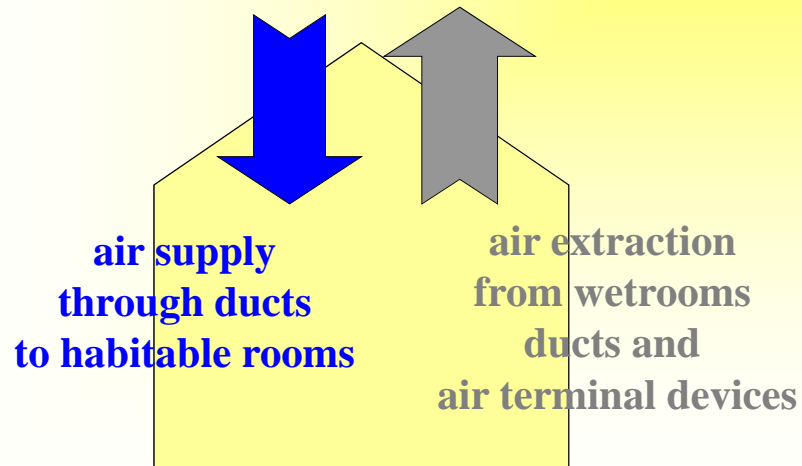
Air tightness in relation with extract ventilation system

- Infiltrated air
 - can be part of the air supply in case of extract systems
 - Demand controlled extract systems with CO₂ sensors don't see the difference of air coming through cracks or through intended inlets

Ventilation system
mechanical supply and
mechanical exhaust



Intended flows balanced ventilation systems



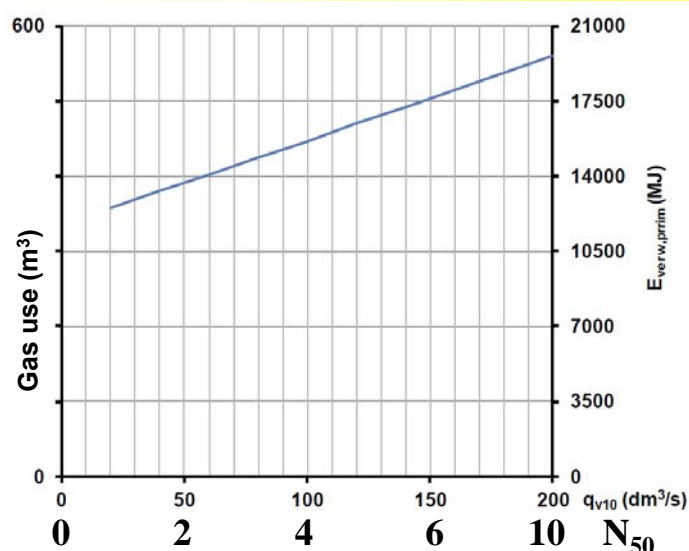
Air tightness in relation with balanced ventilation system

- Infiltration = exfiltration
- Improving the air tightness is more beneficial for balanced systems than for extract systems !
 - So is balancing the flow with these systems wise
or
should you on purpose unbalance the flows to reduce exfiltration:
a little more extraction than supply ?

Relation Air tightness versus Energy use

- Infiltrated air must be heated up to comfort level
 - Energy penalty ?
 - Relation Linear ?
 - Physically not, but ?

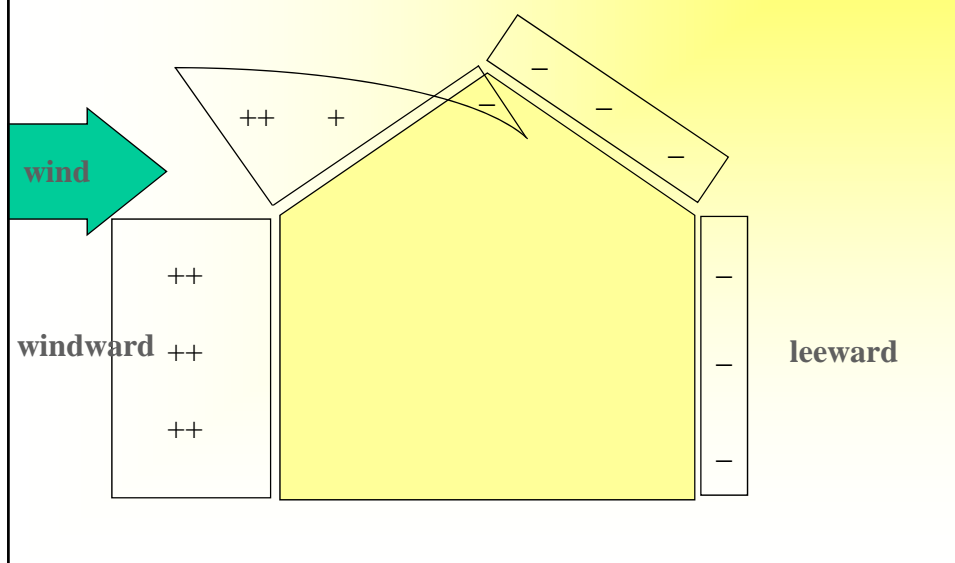
Effect of air tightness on energy according NEN8088



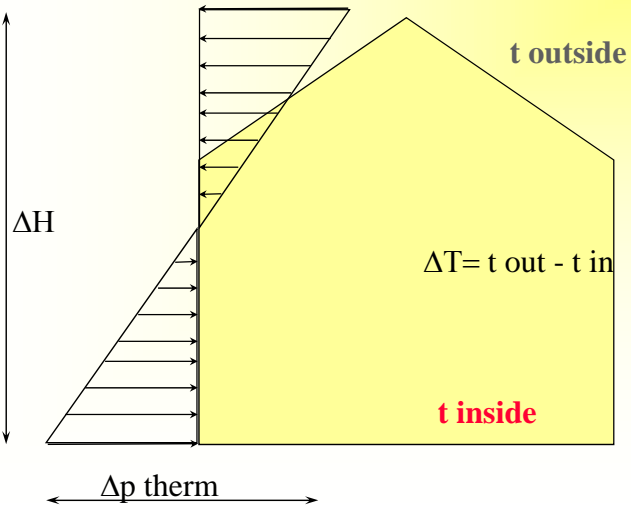
Relation energy use versus infiltration not linear

- Reasons:
 - Pressure distribution
 - Leakage distribution
 - Type of ventilation system
 - Use of ventilation provisions in real life

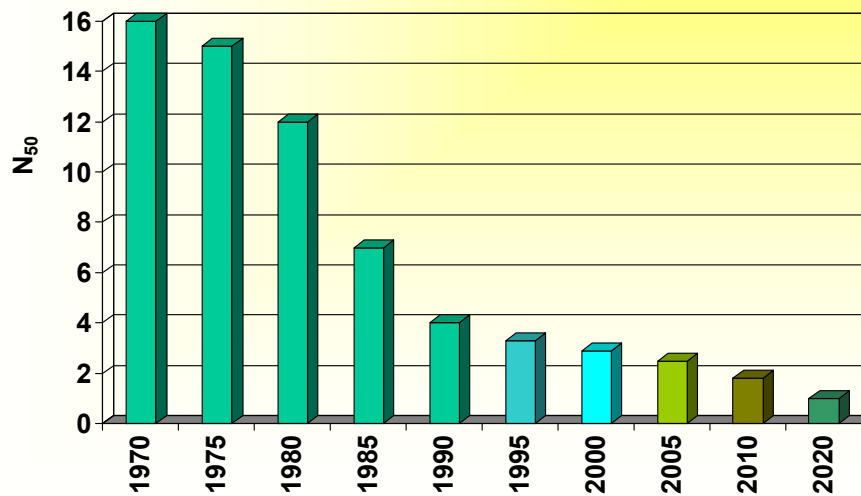
Wind pressure distribution



Pressure distribution due to temperature differences



Air tightness Typical Dutch houses



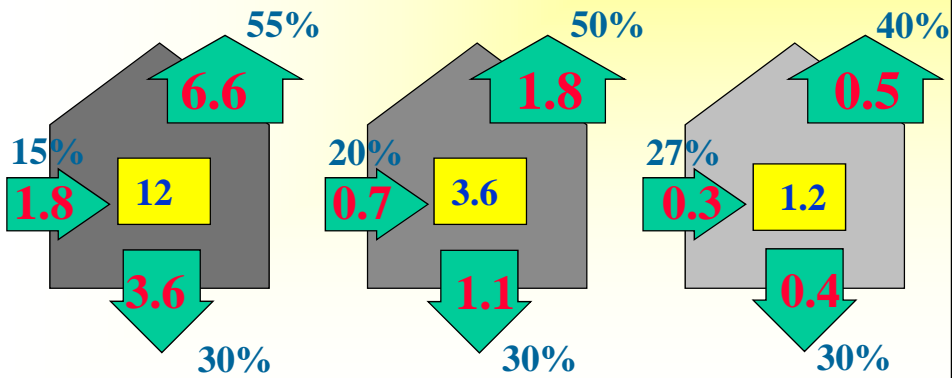
Source: TNO

Air Tightness and Leakage Distribution

1980

1990

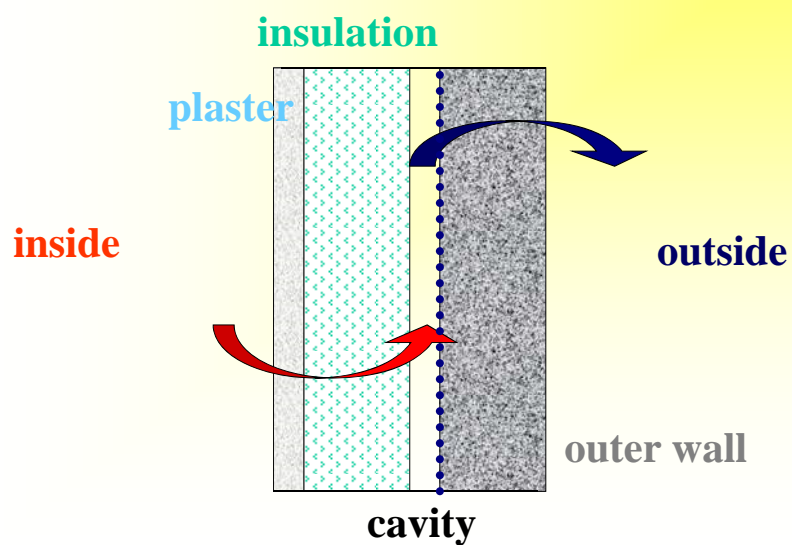
2010



Source: TNO

expressed as N_{50}

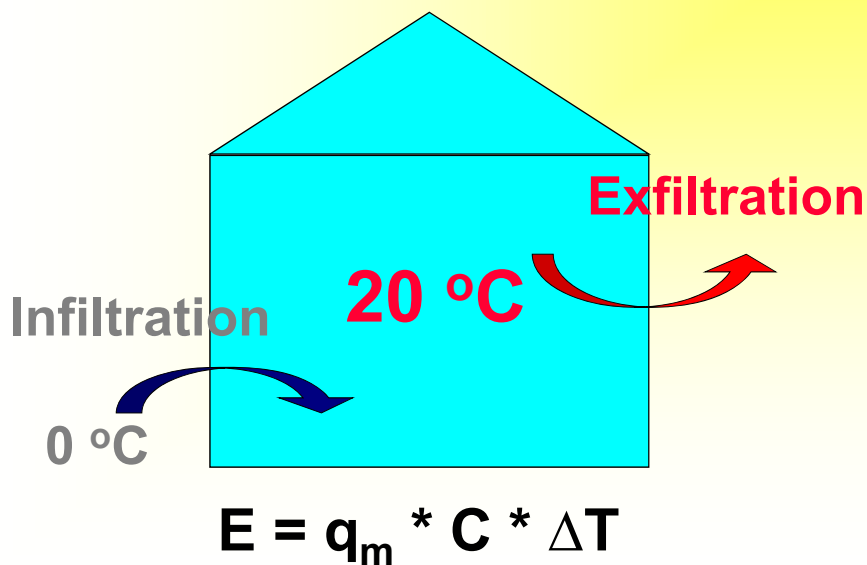
Exfiltration and condensation



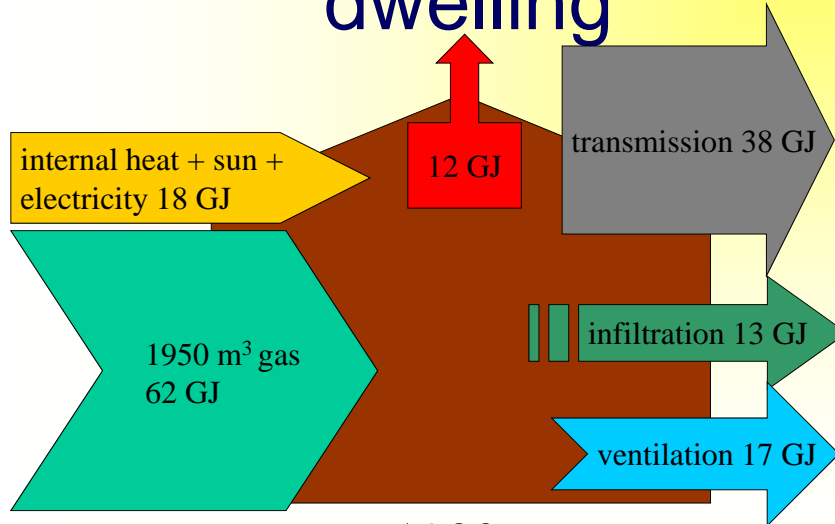
Air tightness in relation to use ventilation system

- Opening air inlets by inhabitants
 - by passes the leakage of the wall
 - Infiltration is decreasing in that wall
 - But the exfiltration may increase because of higher pressure in the dwelling
- Switching the fan often to maximum extract flow and open inlets
 - exfiltration and infiltration are effected

Energy: heating season



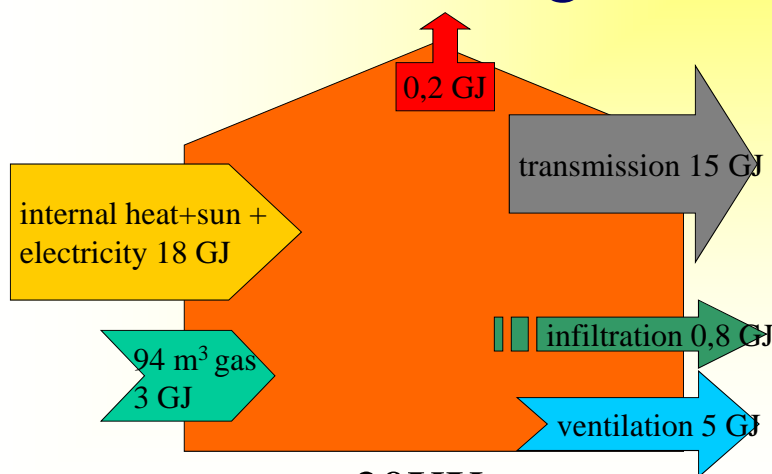
Energy balance existing dwelling



Source; estimation TNO

1980

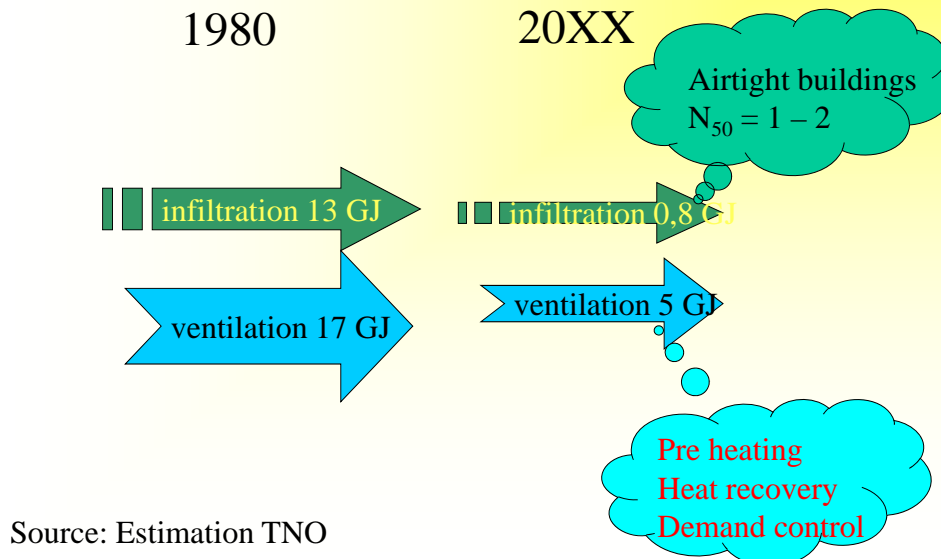
Energy balance future dwelling



Source; estimation TNO

20XX

Evolution of energy consumption ventilation and infiltration



Concluding remarks

- The relation between air tightness and energy use is principally not a linear one
- The relation depends on many aspects such as:
 - Type of ventilation system
 - Use of the ventilation provisions
 - Leakage distribution over the outside envelope
 - Pressure distribution
- In practice however a linear relation is often used
- For a specific house and a specific ventilation system the linear approach might be sufficient for energy estimations
- The real relation between energy use and air tightness is much more complex



Thanks for your attention !!!