EXPERIENCES WITH DANISH LOW-ENERGY HOUSES

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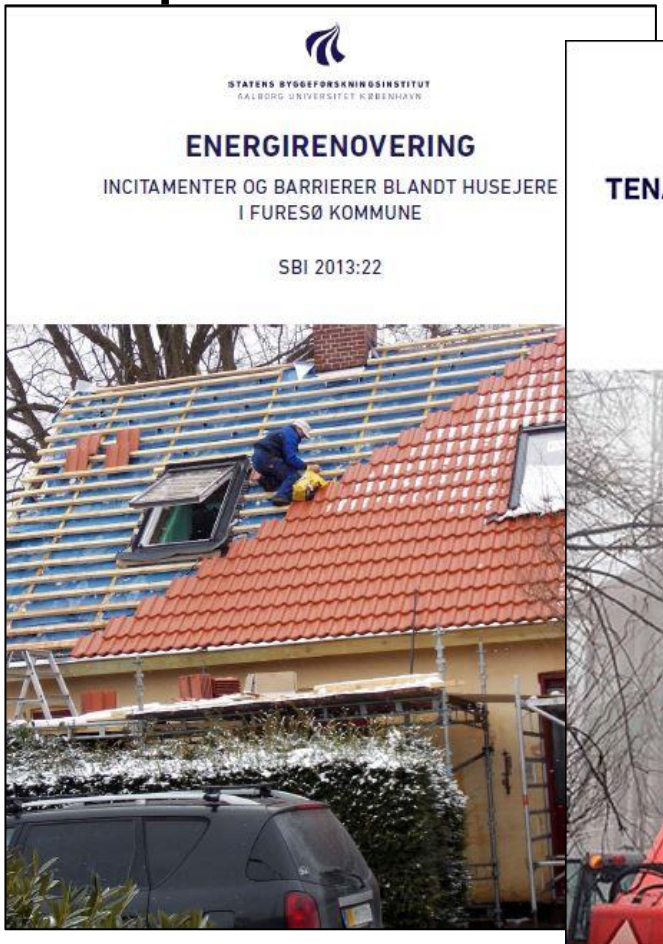
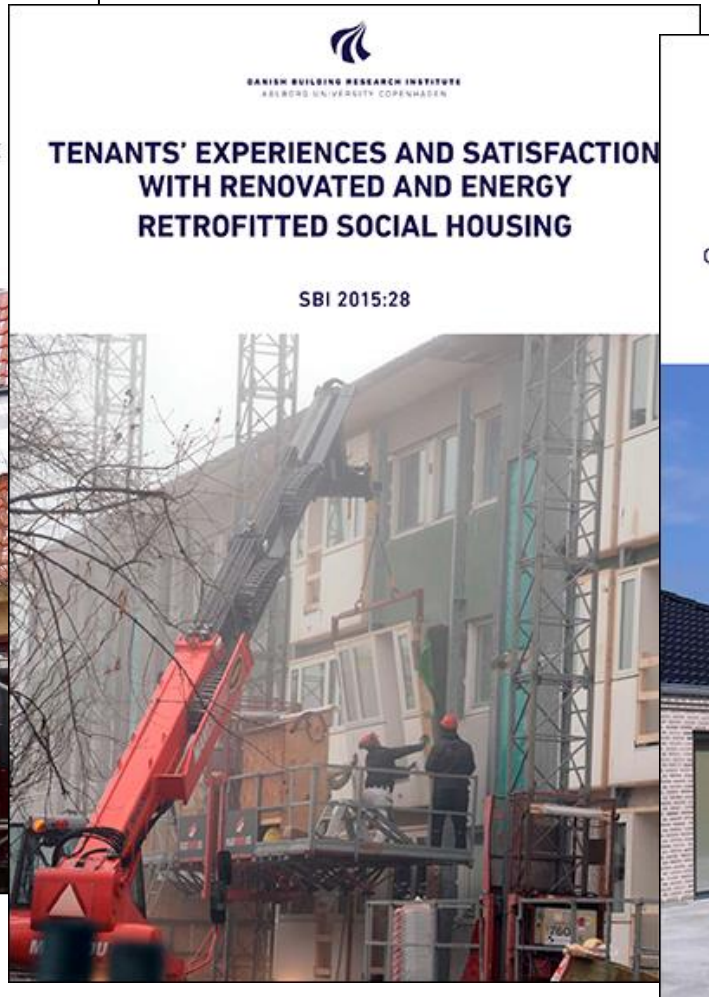
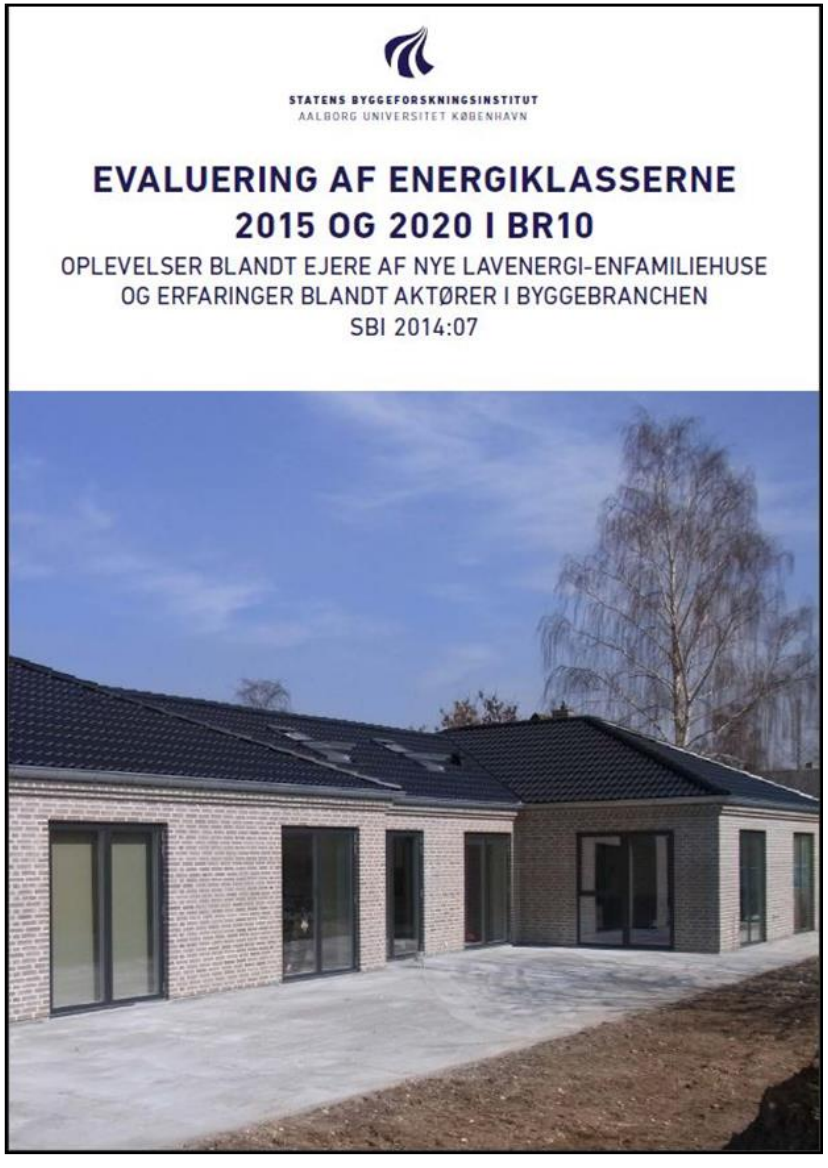
Experiences and satisfaction among occupants







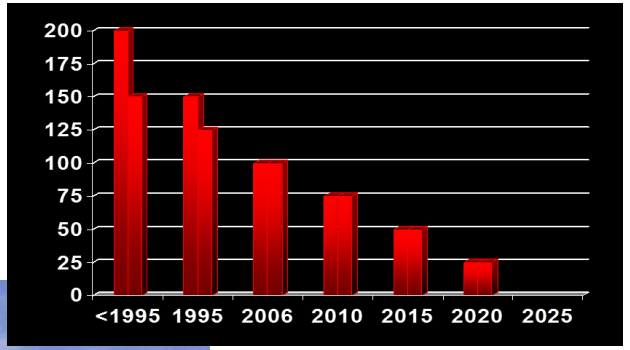
Objective

Evaluate experiences and satisfaction with the new generation of **low-energy class 2015** detached single-family houses

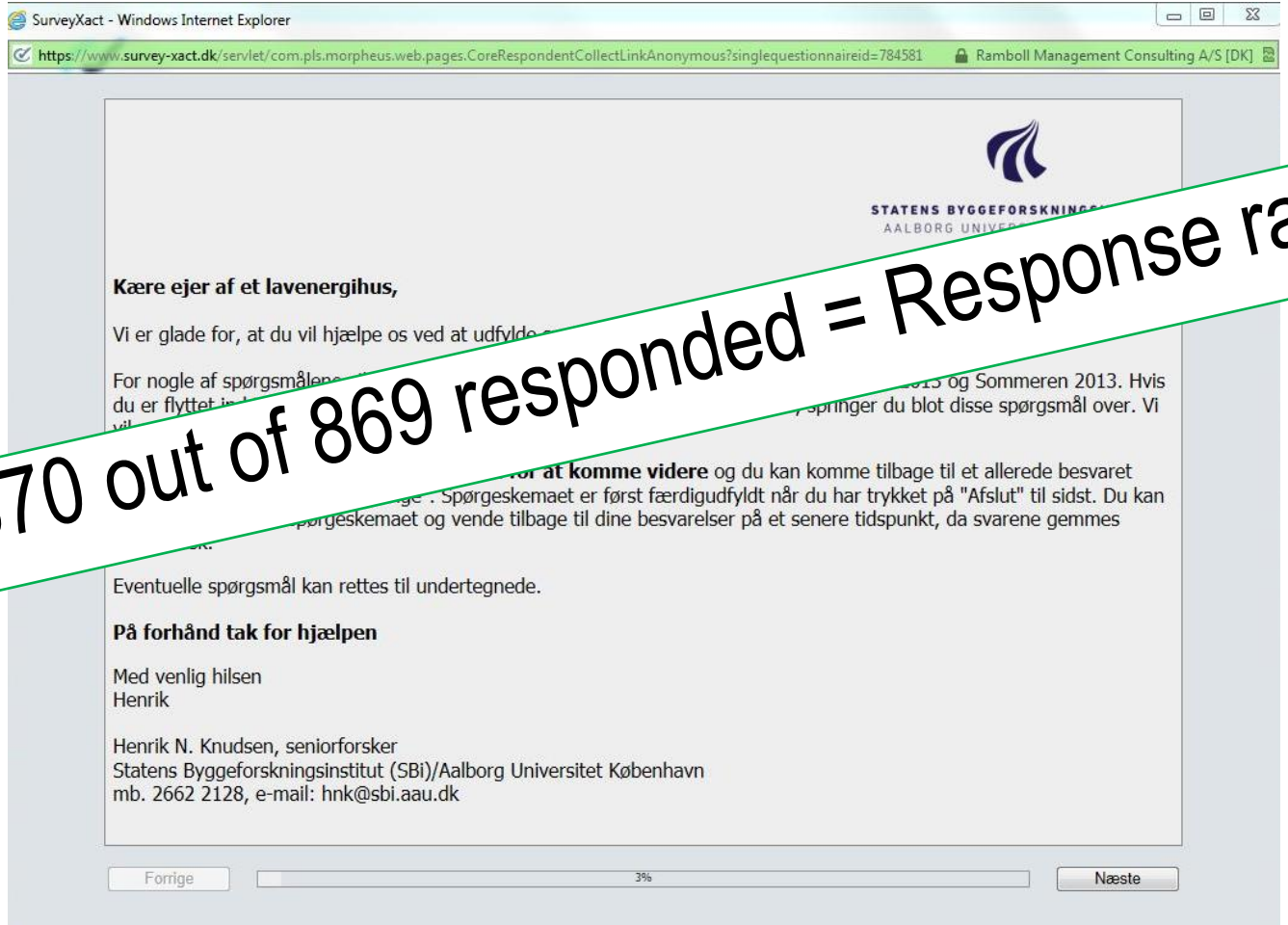
This presentation

- “The low-energy house”
- Technical installations – focus ventilation system
- Satisfaction with perceived indoor climate – focus perceived IAQ
- What we (maybe) can do…

“The low-energy house”



Questionnaire survey



370 out of 869 responded = Response rate of 43 %

Questions

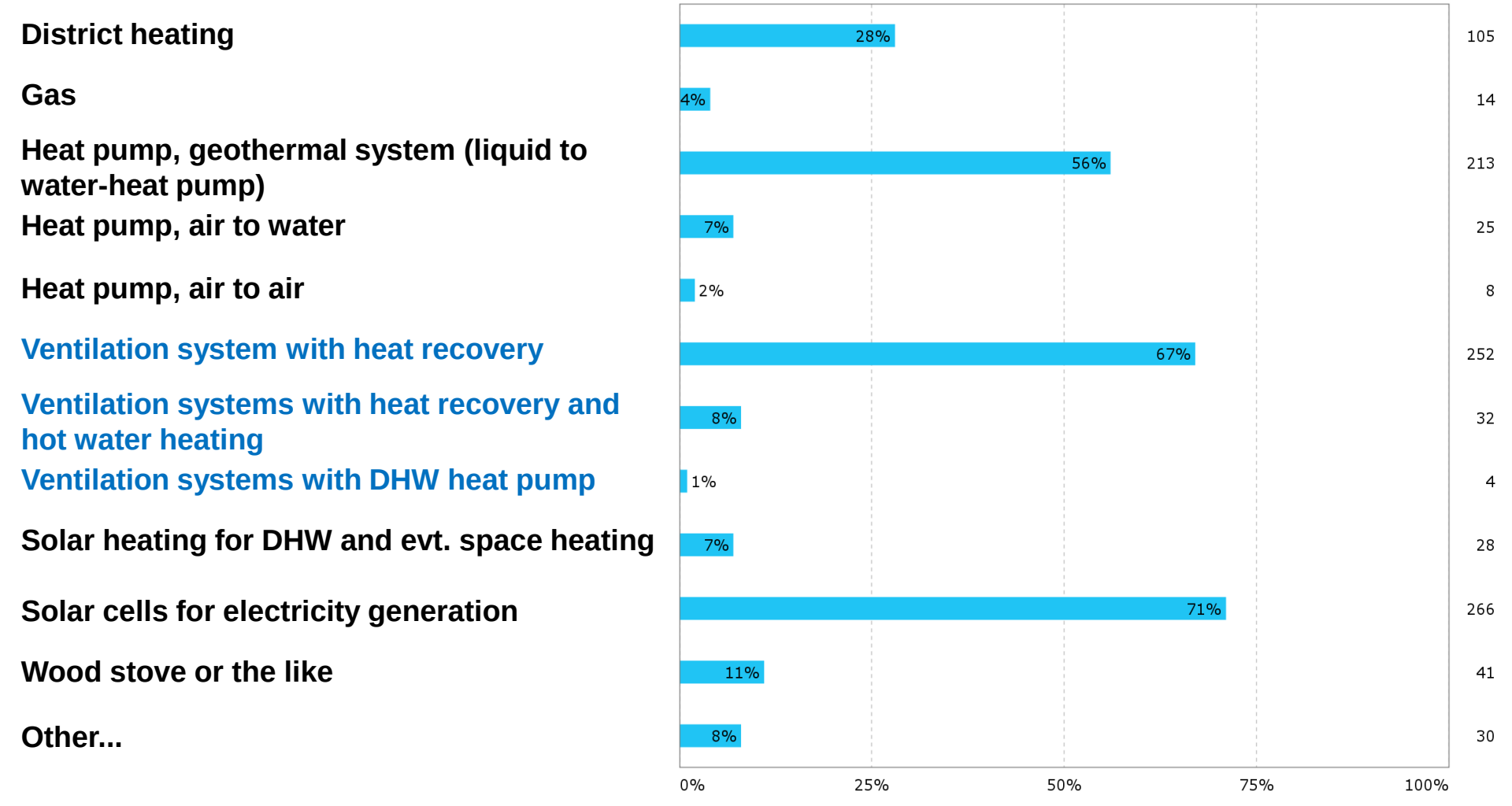
???

- The houses/Technical installations
- Overall satisfaction
- Specific satisfaction
  - Perceived indoor climate
  - ..

”The low-energy house”

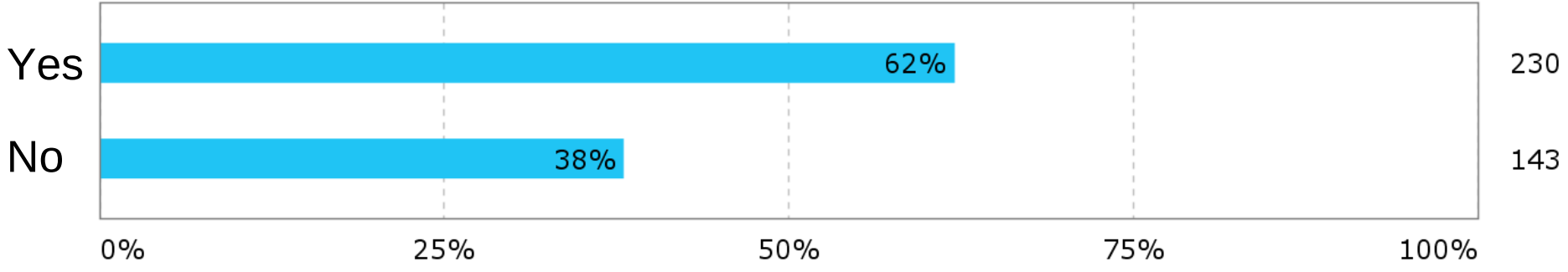
- Low-energy class 2015 (Building Regulations 2010)
- Average size: 186 m^2
- Ventilation systems with heat recovery (76%)
- Heat pump (65%)
- Floor heating (94%)
- PV (71%)

Technical installations



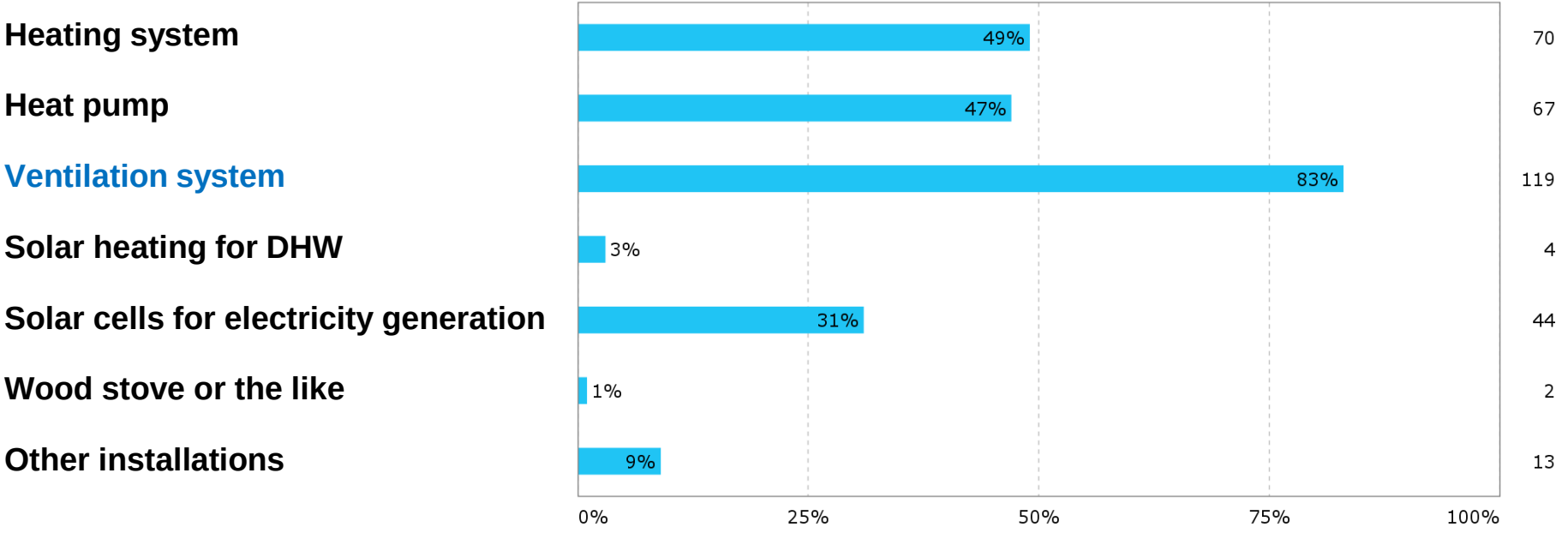
Information - Technical installations

Do you find that you have been given enough information about how the house's various technical installations works?



Information - Technical installations

Which of the following installations are you lacking information about?



Technical installations

- Houses are getting more complicated
  - Ventilation system
  - Heating system / floor heating
  - Geothermal heat / heat pump
  - Photovoltaics
  - Solar heating

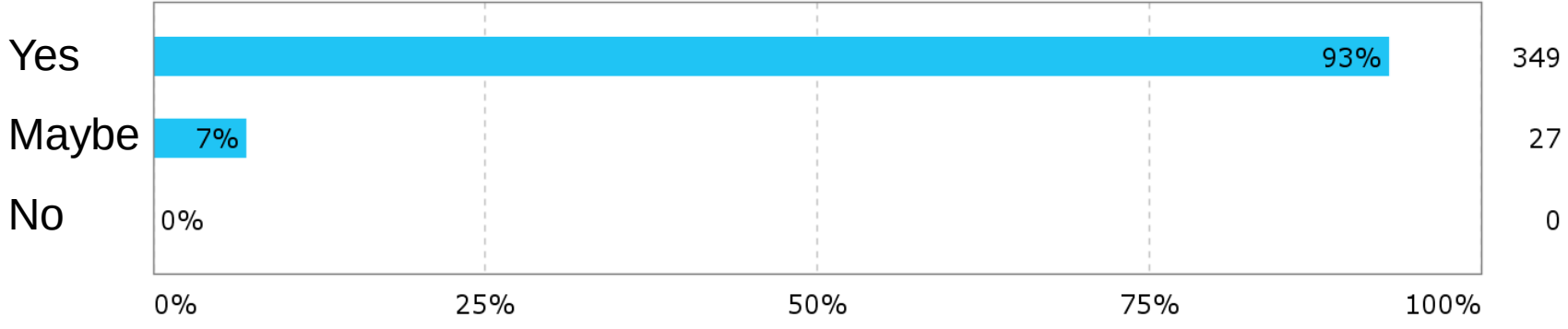
Ease of use, please!!

”The system is so complex that it's hard to remember what to do for the proper operation of installations”

”The manual is intended for engineering nerds”

Overall satisfaction

Can you recommend others to live in a low-energy house?

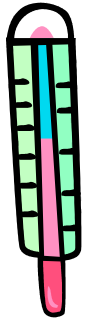


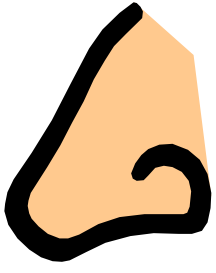
Justifications:

Good indoor climate and low energy and operating costs

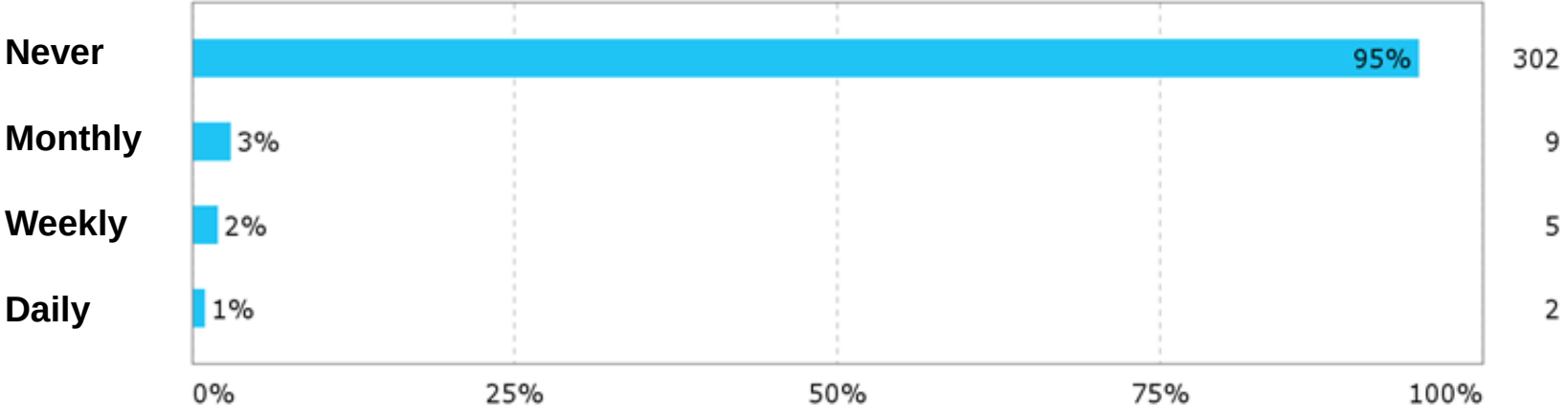
Perceived indoor climate

- Temperature
- Draught
- Noise
- **Air quality**
- Daylight



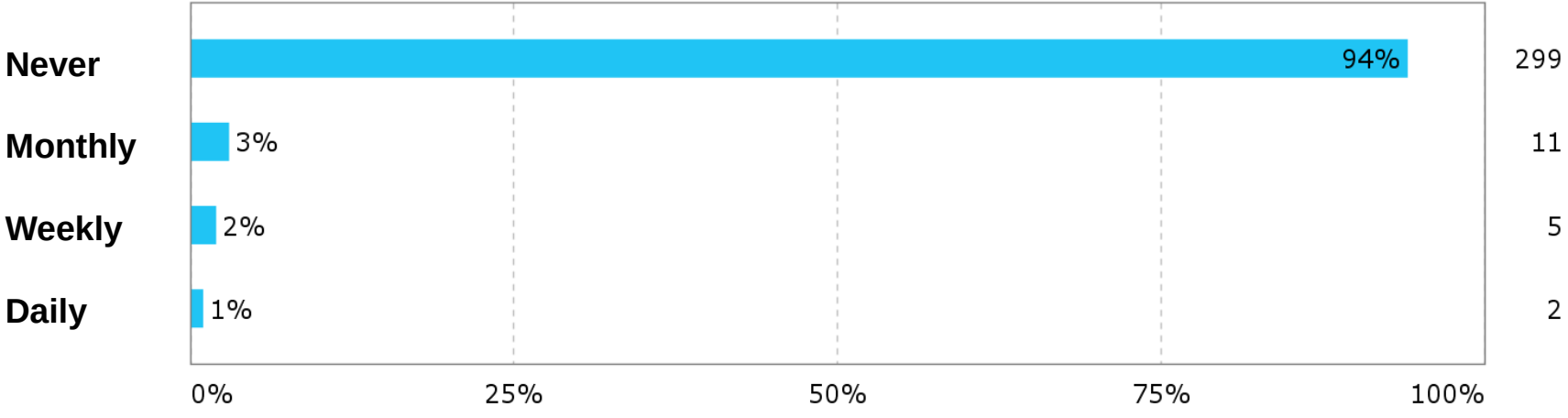


How often have you perceived problems with **unpleasant odour**?



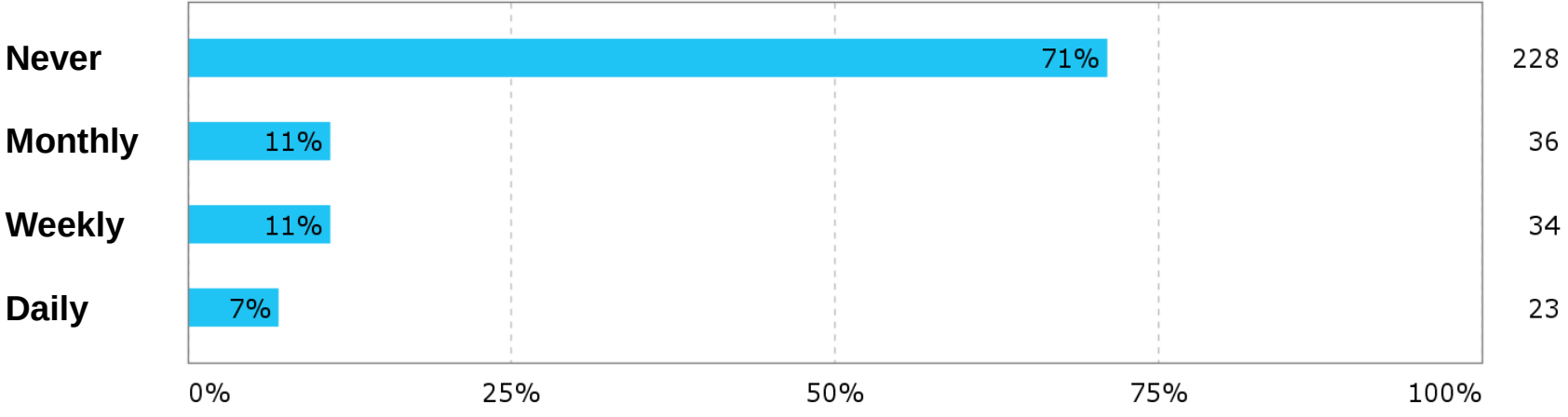
Winter 2012-2013

How often have you perceived problems with **stuffy air**?



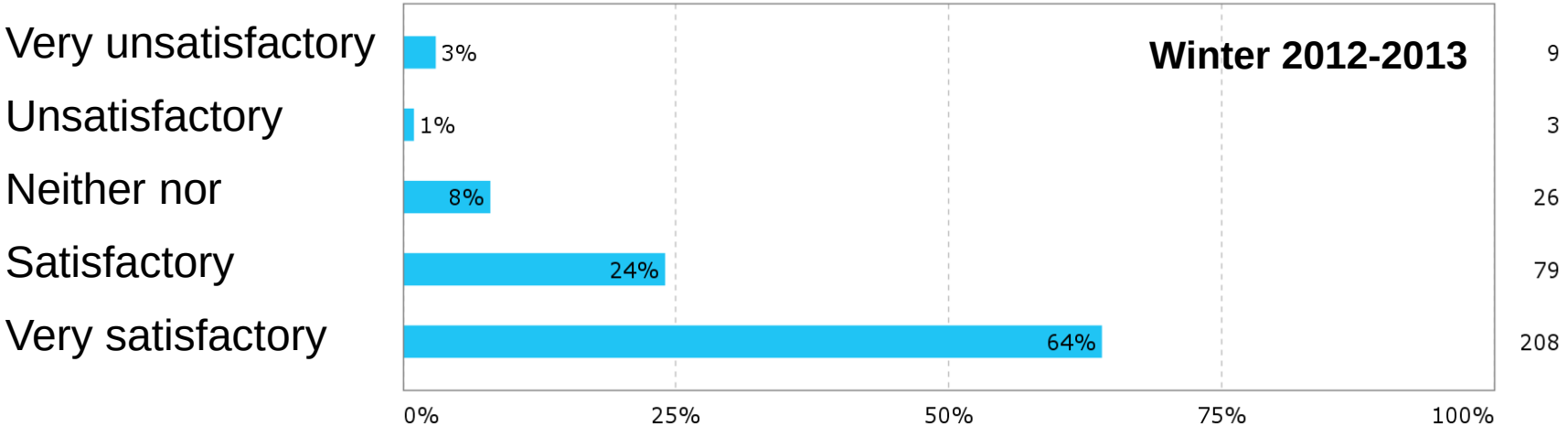
Winter 2012-2013

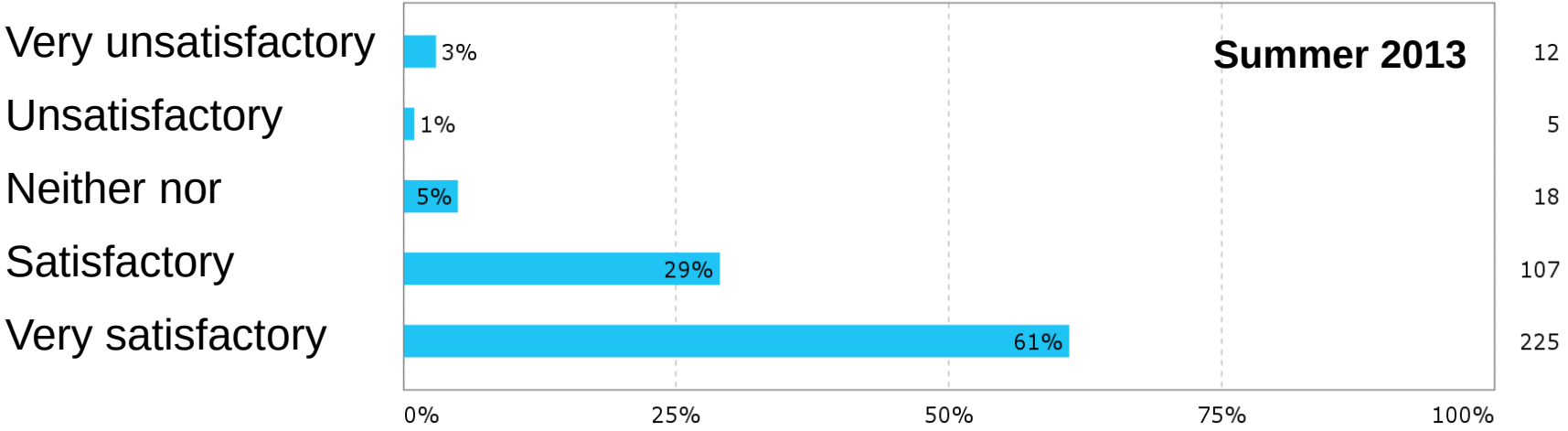
How often have you perceived problems with **dry air**?



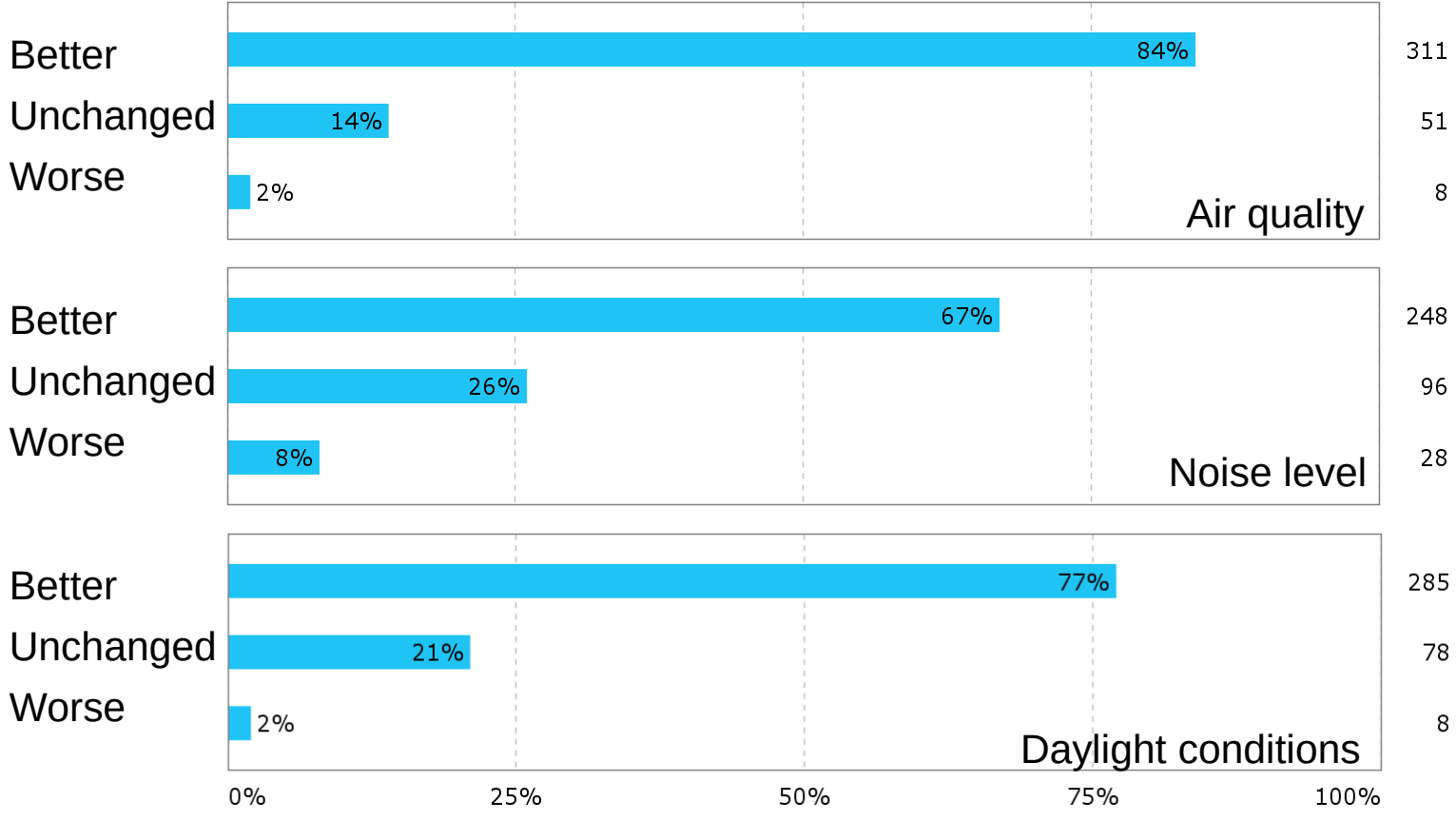
Winter 2012-2013

How did you find the **air quality** in your house?

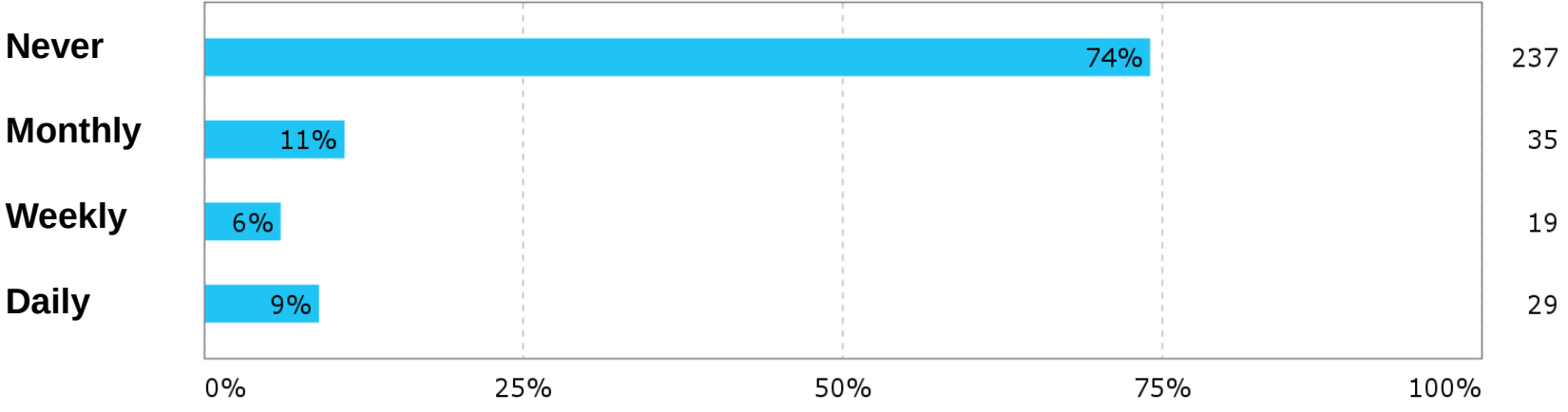




How do you find the **air quality** in your new house compared with your previous dwelling?



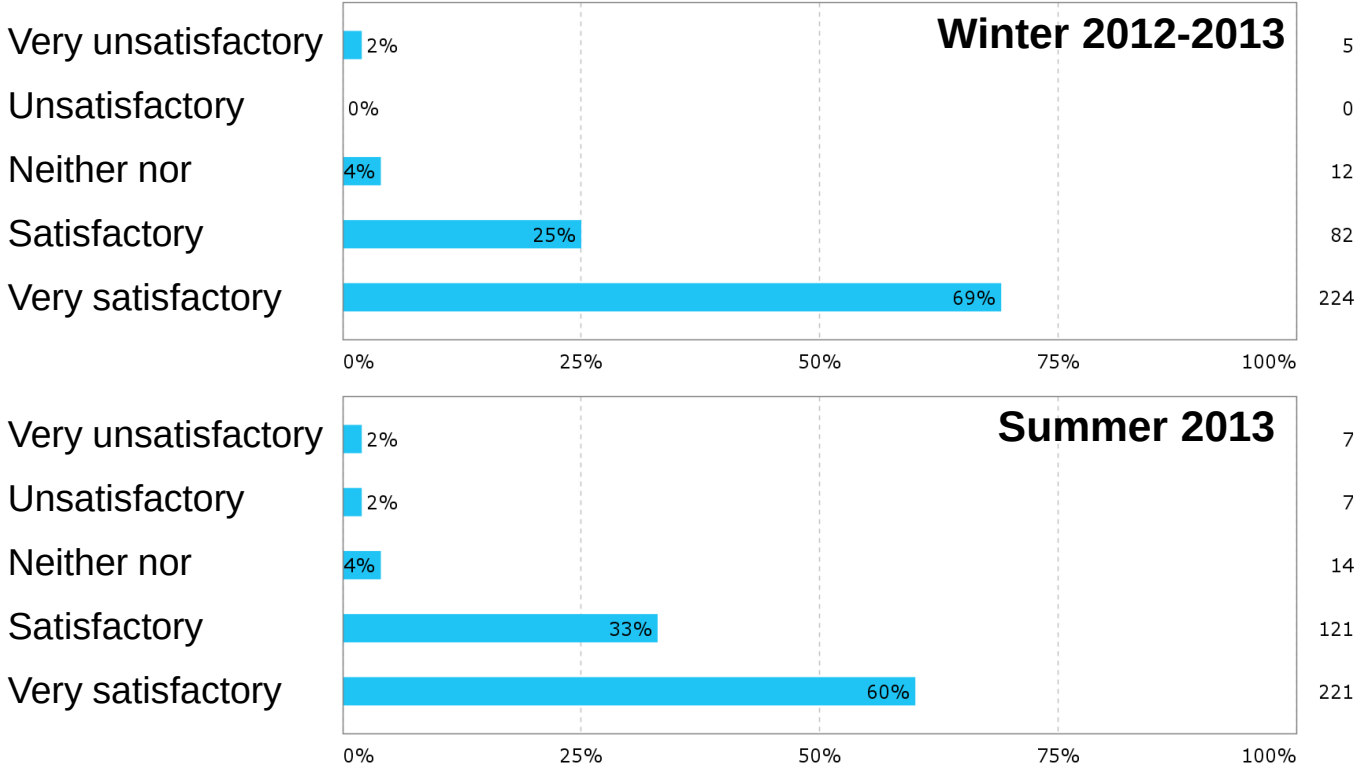
How often have you perceived problems with **noise from the ventilation system**?



Winter 2012-2013

Taking everything into consideration…

How would you rate the **indoor climate** in your house?



Conclusions

- Overall satisfaction with low-energy houses
- The indoor climate is perceived positively

Remember (to satisfy occupants)

- Pollution sources…
- Ventilation – how much?, when?, where? …
- Avoid high temperatures in summer
- Avoid noise from technical installations
- Handover procedure – make things work from day one
- Robust and user-friendly technical installations
- Bedroom/children's rooms may need special attention during the design of ventilation soloution/system
- Align expectations
    - Comfort and energy

Strategy for good IAQ

- Source control
- Ventilation
  - Constant
  - Demand-controlled?
- Air cleaning

Danish Building Regulations 2015 (BR15)

6.3 Air quality

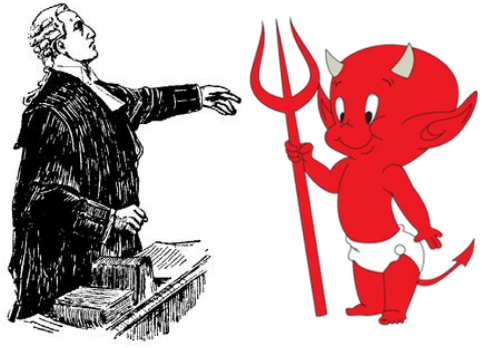
6.3.1 Ventilation

Buildings must be ventilated. Ventilation systems must be designed, built, operated and maintained so as to achieve **satisfactory air quality and humidity** conditions while they are in use.

6.3.1.2 Domestic buildings

- Fresh air supply: **0.3 l/s per m^2**
  - In each habitable room
  - In the dwelling as a whole
  - Similar to **0.5 times air change rate (h^{-1})**

Devils advocat…



What we (maybe) can (in an unoccupied dwelling)

- Provide the prerequisites for good IAQ

What we (definitely) can't (in an occupied dwelling)

- Control occupant behaviour
  - Non building materials
  - Consumer Products
  - Humidity

It will be very hard to convince authorities to lower/change the requirements for ventilation rate in dwellings…

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