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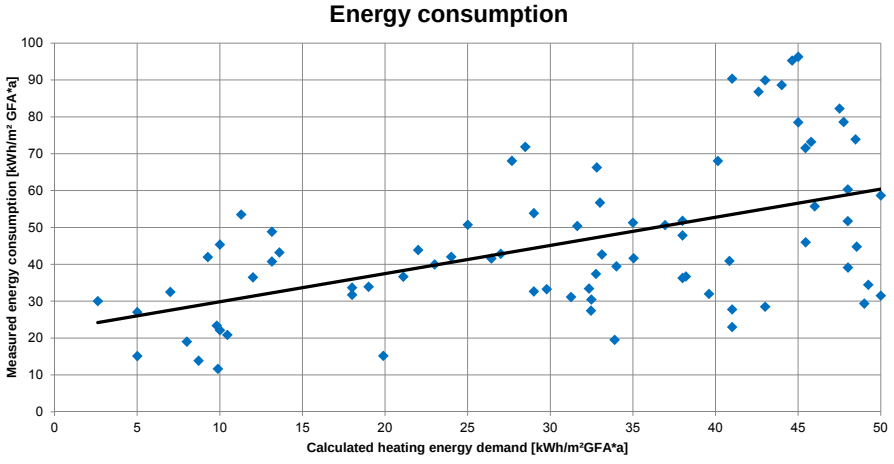
Innovative Buildings in Austria
Consumption and Cost Data
Cost Optimality Approach
Lessons Learned

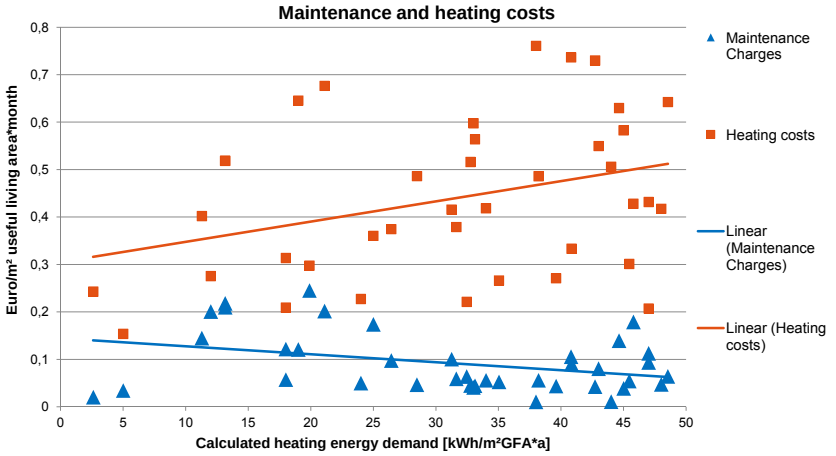
Calculated energy heating demand vs. measured energy consumption



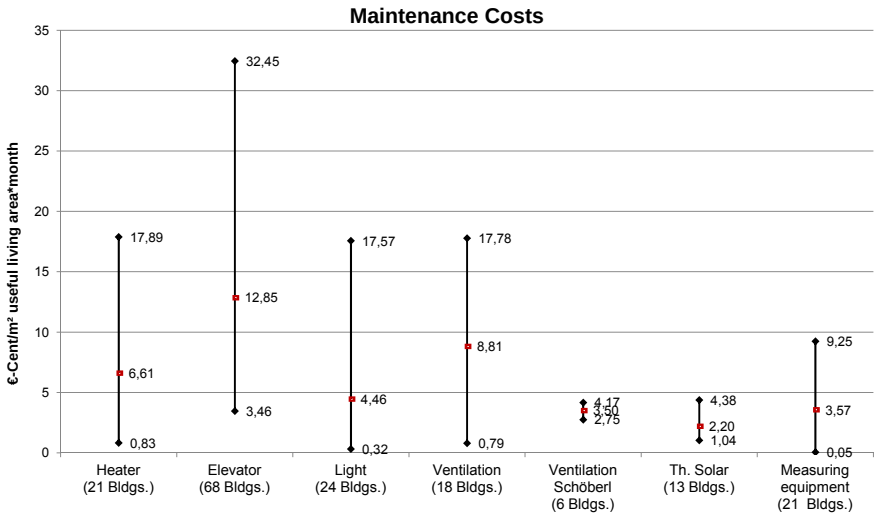
Number of buildings: 82
Big variation of consumption within same theoretical heating demand class
Assumption concerning hot water consumption: 20,4 kWh/m² GFA*a

Innovative buildings
Operating costs vs. heating costs

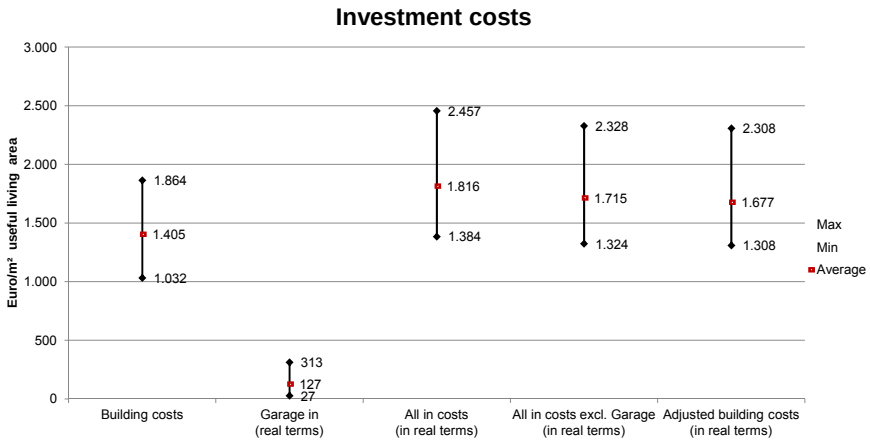
- nZEB require significantly less energy than low-energy house
- Additional costs for electricity and maintenance of the ventilation system



Maintenance costs

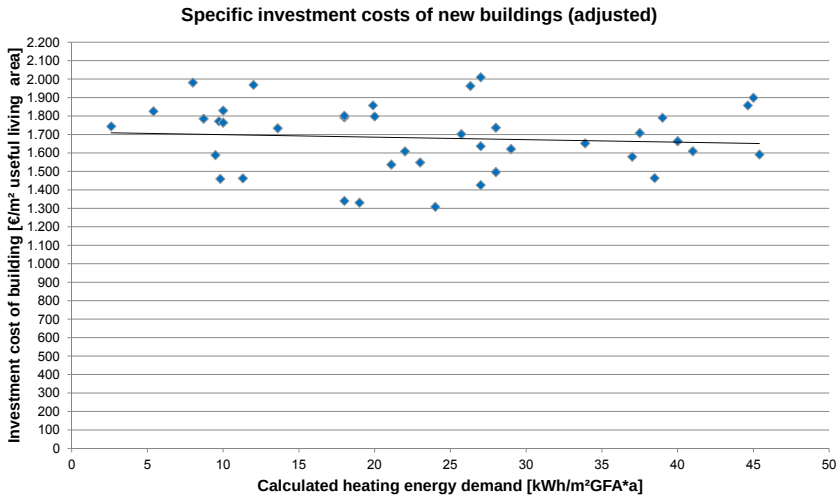


Investment costs



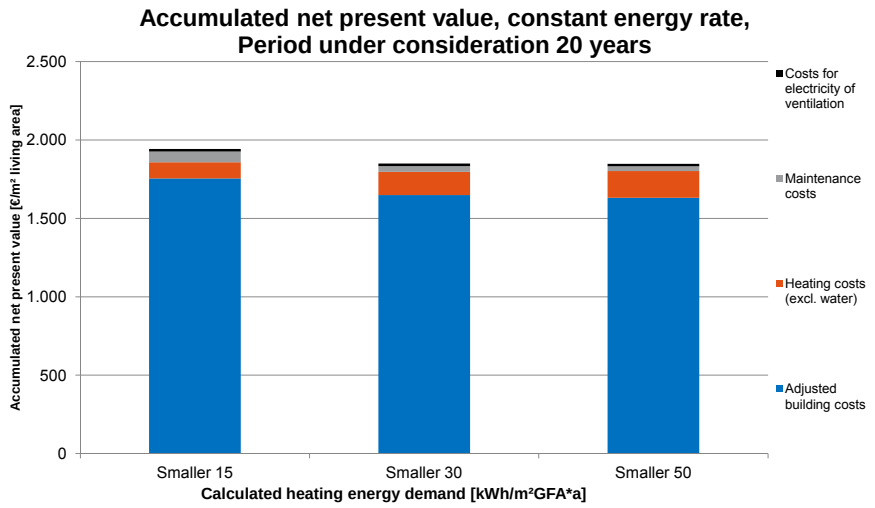
Buidling costs are adjusted by garage, elevator and size of the flat

Specific investment costs



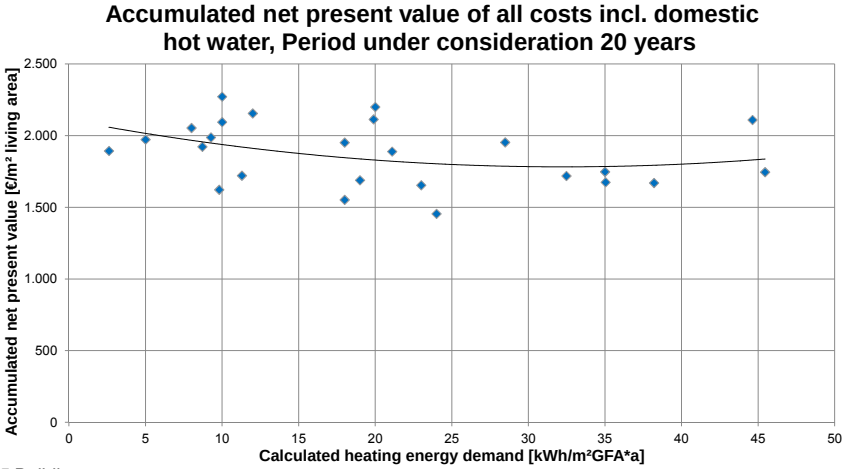
44 Buildings

Accumulated net present value



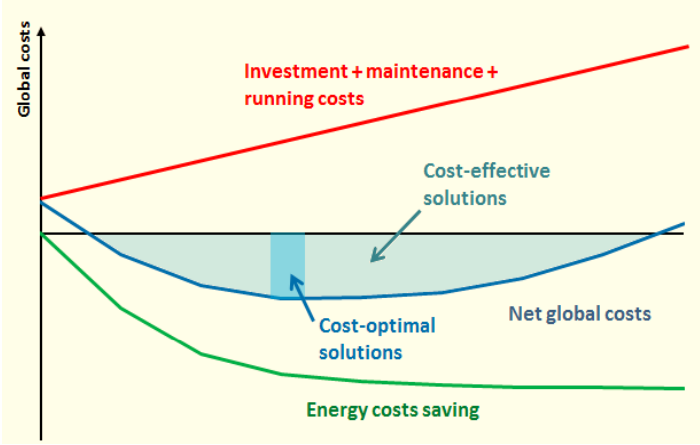
Constant energy rate 0,10 Euro/kWh

Cost optimal building standard



25 Buildings
All costs = maintenance costs + energy costs (heating and hot water) + costs for electricity of ventilation + adjusted building costs
Discount rate = 1%, energy price development = 2,8%, other price development= 0% (all in real terms)

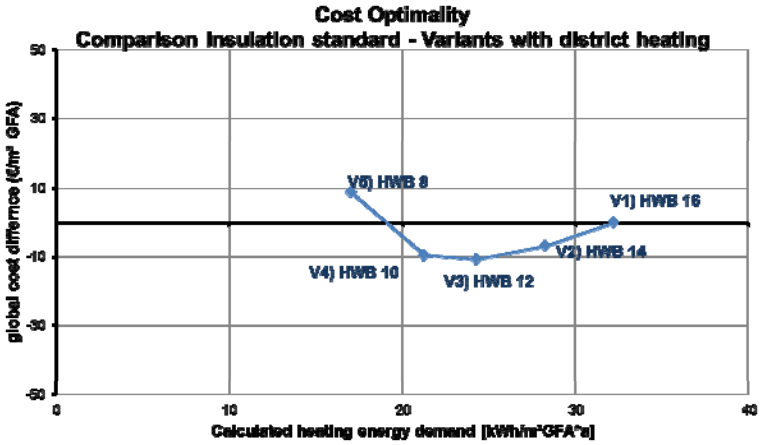
Cost Optimality Methodology



Relationship between cost-optimality and cost-effectiveness

Source: BPIE Study Cost-Optimal methodology (not published yet)

Cost optimality – theoretical calculation



Variants: Stepwise improvement of the insulation standard ranging from actual minimum requirements in Austria (HWB-line 16; V1) to passive house envelope (HWB-line 8; V5) – Global cost difference compared to actual minimum requirements
Energy price developement 2,8%(in real term), residual value is taken into account

nZE Buildings: Energy consumption

- The measured energy consumption for heating in NZE-buildings is in reality significantly lower than in low-energy-buildings. Data show also a broad variance of real consumption data of about factor three within each group. Therefore it could be quite misleading to draw far-ranging conclusions from single objects or a very limited number of buildings.
- Maintenance costs were becoming an increasingly important issue mainly due to mechanical ventilation systems, which are a crucial element of the passive-house-concept but also more and more frequently installed in lowest-energy buildings due to air-tight construction.

nZE Buildings: Maintenance costs

- There can also be observed a broad variety of maintenance costs in practice. Maintenance costs for ventilation systems range from 0,8 till 18 ct/m².month with an average of about 9 ct/m²m.month, depending mainly on the system (central or decentralized ventilation, frequency of filter exchange, quality of filters and adequate contracts with external maintenance contractors.
- Best practice studies for a limited number of 6 buildings show that the maintenance costs for central mechanical ventilation systems can be limited to a range from 3 to 4 ct/m².month, whereas decentralized ventilation systems result in maintenance costs of 10 ct/m².month on average.

nZE Buildings: Maintenance and investment costs

- **Buildings with ventilation systems trend to have higher maintenance costs compared to buildings without ventilation systems. Consequently, lower energy costs for heating which can observed in lowest-energy and passive-house-buildings are tending to be partly compensated by higher costs for maintenance.**
- **Specific investment costs (€/m² used floor area) are depending on different factors: most important of them the size of a building, since small and less compact buildings have significantly higher specific costs than large and very compact buildings. Further cost components which influence the comparability of building costs are the number of elevators and if there is an underground garage for each dwelling or not. Furthermore regional differences in building cost levels can be generally observed.**

nZE Buildings: Investment costs

- **Specific investment costs for individual buildings vary considerably, the trend line results in additional specific costs for passive-house buildings of about 100 €/m² compared to low-energy standard (which is mandatory in Austria since 2012). A more detailed analysis show, that the additional costs for passive-house standard seems to be significantly lower for large and compact buildings (appr. 40-80 €/m²) compared to additional costs for small and less com pact buildings (appr. 120-200 €/m²).**

nZE Buildings: Total costs, cost optimality

- **Putting together the data on running costs and investment costs in a simplified total cost calculation over 20 years (net present value, without reinvestments for technical installation, 3% energy cost increase per year) the results show that lower costs for energy heating do not compensate the higher investment costs for passive-house standard in general. At least for the specific situation in Austria it seems, that lowest-energy standard (energy heating demand about 25-30 kWh/m².a) turns out to be a cost-optimal building standard.**
- **Approximately, this seems to be in line with theoretical calculations on cost-optimal building standards for multi-family-residential buildings in 2012.**
- **Reference: see NZC report by e7, January 2013 (Del D 2.1b)**

First Pilot Projects


Seite 14 ÖSTERREICH Montag, 17. Dezember 2007

Neue-Heimat-Mieter in Innsbruck klagen

„Da hilft nur der Einbau einer zweiten Heizung!"

Seit zehn Jahren schlagen sich die 60 Mieter der Neuen-Heimat-Häuser am Innsbrucker Mitterweg 157 und 159 mit einer Heizung herum, über die auch Experten den Kopf schütteln. Kälte, Zugluft, Staub, Trockenheit – das macht den Mietern zu schaffen. Die „Tiroler Krone" hat mit einem Spezialisten gesprochen. Der plädiert für den Einbau eines zweiten Heizsystems.

Wie gestern berichtet, sind die Mieter der beiden Neue-Heimat-Häuser mit ihren Nerven am Ende. Vor zehn Jahren wurde ihre Anlage als innovatives Projekt vorgestellt. Doch es gab von Beginn an Probleme. Die Neue Heimat räumte da-

In dieser Anlage der Neuen Heimat am Innsbrucker Mitterweg sind die Mieter nach zehn Jahren Kampf mit der Heizung nervlich am Ende.

Montag, 17. Dezember 2007 ÖSTERREICH

über Kälte, Zugluft und Straßenstaub in ihren Wohnungen ● Experte zur „Krone

Einbau einer zweiten Heizung!"

und über die Luftschächte wird der Straßenstaub direkt in die Wohnungen geschleudert. All diese Mängel haben die Bewohner aufgeschrieben.

All diese Mängel kennt auch Matthias Kreidl, Chef einer renommierten Heizungs-, Sanitär- und Elektrofirma in Kramsach. „Eine Warmluftheizung würde ich maximal in einem Zweifamilienhaus empfehlen.

VON CLAUDIA THURNER

Source: Krone Newspaper

First Projects (heating only with preheated air) did not work very well

Refit of an additional heating system was necessary

User were not satisfied with ventilation system

Best Practise Vienna
First Passive Houses 2006

Passive House Utendorfgasse (39 dwellings)

Source: Schöberl&Pöll

Dreherstraße (27 dwellings passive house, 108 dwellings lowest energy)

Source: BUWOG

Best Practise Vienna

Passive House settlement Eurogate (Until 2019 approx. 1600 dwellings)

Source: city vienna, Schöberl&Pöll

Universumstraße (46 dwellings)

Source: klima:aktiv

Mühlgrundgasse (54 dwellings)

Source: BUWOG

Best Practise Tyrol

Passive House Lodenareal (350 dwellings) and passive House olympic village (444 dwellings)

Source: Neue Heimat Tirol

Best Practise Refurbishment Historic building Vienna

Wißgrillgasse (27 dwellings)

Source: Gassner&Partner

Best Practise Refurbishment Building from the 1950‘s - Linz

Markatstraße (50 dwellings)

Source: gap-Solar/GIWOG

Best Practise Refurbishment Building from the 1970‘s - Vorarlberg

Rankweil (18 dwellings)

Source: VOGEWOSI

Process
Planning and quality assurance

- **Integral planning process (rely on experienced planers)**
  - Special thermal bridge solutions
  - Airtightness concept
  - Interaction between the building envelope, the ventilation system and the heating system
- **Professionals: put the know-how of the planners into practice**
  - Trainings with the professionals at the site
  - Design of a show flat
  - Measuring the air tightness in the show flat → the professionals are sensitised for possible sources of error
- **Quality assurance applies to all professionals**
  - Security of costs
  - Optimal operation of the building

Ventilation System
Heating without conventional Heating System?

- **Passive houses with an air heating system work technically well → planned by experts**
  - Corner flats or exposed areas requires an additional heating system
  - Hard to achieve high comfort (humindity, individual room control)
- **Numerous large-sized passive houses are currently equipped with an additional conventional heating system**
  - Increases the costs, but meets the occupants habits (comfortable, easier to control)
  - With an additional heating system you are “on the safe side”
- **Control of the ventilation system has to be adapted to the needs of the occupants, not to the requirements for heating**
  - Users’ absence → the ventilation has to be reduced
  - Air supply regulation adapted to the occupants’ needs does not go along with the necessary air requirements for heating the building

Ventilation System
Central or decentralised systems

In Austria both systems are common

- right solution depends on weighing advantages & disadvantages

+ Sound protection requirements are easier to implement
+ Minimised maintenance efforts
- Dimensioning & regulation in each flat are more difficult
- Assembly in unheated areas or on roof lower the efficiency of heat recovery
- Billing to tenant is more complicated

+ individual calculation of air quantity in each flat is easier
+ Billing is less complicated
- More components and is generally more expensive
- Higher maintenance efforts
- Occupants can switch off the entire ventilation

25

Ventialtion system
Simple controllability

- **Experience shows that occupants should have possibilities to control the ventilation**
  - 1 – OFF (=base load, minimum ventilation in agreement with the property developer)
  - 2 – Standard
  - 3 – Party (setting to temporarily discharge greater amounts of air)
- **Automatic, demand-based regulation is a constructive solution which means switching off the ventilation system in the absence of the occupants (by presence detector, humidistat, carbon dioxide sensor etc.)**

  → High comfort

Ventilation Systems
Maintenance and cleaning

- **Filter change: Occupant should NOT be responsible due to lacking requirements**
- **Maintenance: should be performed regularly by a specialist company**
- **Ventilation ducts and components have to be delivered and stored dust-proofed**
  - Ducts have to stay dust-free inside throughout the entire construction period
- **Ventilation ducts have to be cleanable**
  - Therefore, short ducts with as few directional changes as possible
  - Flexible air ducts (aluminium) cannot be cleaned
- **In Sweden, for example, an inspection every three years is mandatory**

Ventilation Systems
Unpleasant odurs

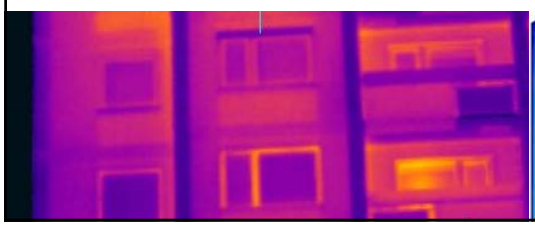
- **Fire safety: detailed planning and careful considerations are necessary**
  - Ventilation system should require an emergency shutdown
  - Fire alarms can be placed inside air ducts which induce an automatic shutdown in the event of a fire
- **Sufficient room between the inlet opening and the air discharge opening outside of the house**
- **Never integrate exhaust hoods of the kitchen into the ventilation system**
- **Determination of suitable location for the fresh air source**

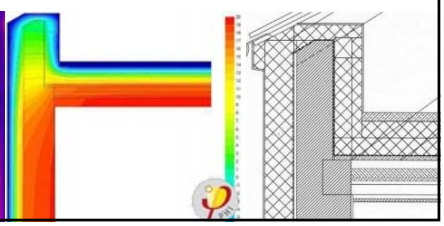
Building Envelope
Air tightness

- **Air tightness is a fundamental component of energy-efficient construction**
- **Necessary to develop an air tightness concept during the planning stage**
  - attention to the connection of building components or to changes in building materials
- **According to the Passive House Institute, a n50 value with less than 0.6 h-1is aspired.**
- **Blower-Door-Test will assure the accuracy and quality of the construction**

Building envelope

- **Avoiding thermal bridge → has to be done during planig phase**
  - Thermal bridge concept for all connections
    - Balkony, attic, window joints, connection cellar
    - Thermal bridge due to different materials
- **Air-tight window assembly**
- **Quality assurance!**





Heating systems

- **The heating temperature should be reduced to gain higher efficiency (especially for the systems: Active solar energy, heat pump and district heating)**
- **Insulating the distribution system is cost-effective and saves energy (shorter distribution distances!)**
- **The examination of all heating components by the building inspection is necessary for all flats, in case of reheaters or control devices not being properly connected**
- **The passive house is a "sluggish" system (heating slow, cooling slow)**
- **In case of refurbishment, flow temperature have to be reduced**
- **Heating system has to be hydraulically regulated before handover**

Summer characteristics

Overheating can be avoided by

- Night-Ventilation: designed and regulated by the planner
- Ratio window area: designed and regulated by the planner
- External Shading: designed and regulated by the planner
- Thermal storage mass: determined by the planner
- Reducing internal loads: parameters depending on the occupant

- **The construction physicist is required to verify critical rooms and stairwells according to the requirements (e.g. national standards)**
- **The possibility to open the windows at night-time must be guaranteed**
- **The information of users about the adequate behaviour in summer and during transition periods is crucial**

Building Ecology

- **Elimination of climate-damaging halogenated chlorofluorocarbons (HCFCs) from insulating wall panels made of extruded polystyrene.**
- **Using less volatile organic compounds (VOCs) as solvents, especially in paints, varnishes, adhesives and prime coats.**
- **Using less polyvinyl chloride (PVC), a synthetic material harmful to environment and health.**
- **Minimising the production energy („grey energies“) of building products by using of renewable materials (especially wood, natural insulation materials based on cellulose, flax, sheep wool, cork etc.) or for the interior finish (wood, linoleum, etc.).**
- **Building ecology from the very beginning doesn`t cause extra costs**

Occupancy Satisfaction
User information

- **Satisfaction not only depends on the quality of the flat, also on the customers' expectations**
  - By informing the customers from the very beginning about the specifics of living in a innovative building, false expectations can be eliminated
- **Information should be passed on through different media**
  - User manual with simple diagrams, pictograms
  - Oral information and instructions concerning the operation of the house at the handover of the house
  - Three to six months after the handover, all occupants will meet to discuss any questions that might have come up (e.g. discussion panel)
  - A corresponding contact person must be available at all times (maintenance man)

Energy-Monitoring

- **Energy monitoring benefits the quality assurance of the building operation**
  - Measurement of energy required for heating and hot water
  - Measurement of electricity consumption for operating the ventilation system
  - Measurement of parameters for comfort (temperature, humidity, CO2)
- **Professionals can check, whether all planning targets have been achieved – Comparison with calculation**
- **divergences (e.g. excessive energy consumption) can be recognised**
- **Energy monitoring is an essential step for optimising the operation and readjustment of the systems engineering**
- **Know-how for following projects can be acquired**

Discussion: How to make use of lessons learned in other countries?

- **check-lists**
- **fact sheets**
- **workshops**
- **training courses**
- **online FAQs**
- **field trips**
- **…**

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