Participation and behaviour: key issues in local energy policies

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ABSTRACT

The ladder of influence by Arnstein (1969) shows steps from manipulation to citizen control. The level of interaction between citizens, authorities and institutions can be placed on this ladder. In the Netherlands new strategies for empowerment in the field of energy performance are emerging, for instance the Climate Festival, the mobile energy office, the ClimateSreet Party. Positive activities such as the IdeaBrewery focus on the quality of the public domain and show many social interactions, including interactions between the local authorities and citizens. Some of these processes aim at sustainable quality of cities, including household energy savings and signal new forms of local democracy.
Studies on energy consumption in dwellings by Guerra Santin (2009) show that only part of the difference in energy consumption between households in similar houses can be explained by differences in behaviour, but her results present an important new picture of user influence on energy use. The National Dutch Tenant Association (Woonbond) follows bottom up processes in the field of CO2 reduction strategies, as part of the National Energy Covenant for the social housing sector. Top down processes that are managed by local authorities and housing associations are connected to bottom up processes by neighbourhood groups. This paper explains how behaviour in dwellings and participation in planning and maintenance are related.

KEY WORDS

Energy consumption, citizen participation, user behaviour, housing

INTRODUCTION

Many new concepts for energy efficient housing are succesfully tested in pilots and then applied on a large scale. The evaluation of these state-of-art projects show a discrepancy between calculated performance and actual performance and higher energy consumption that was expected. Evaluation studies tend to end with the remark that “occupant behaviour has a major influence on the actual performance”, while the actual performance was not studied. Initiatives by housing institutions to invest in energy performance quality often face with lack of support from the tenants. Lack of tenant’s awareness of climate problems, poor willingness to pay for extra quality and inapropriate behaviour are indicated as causes for this problem. Housing associations need tenant support for measures to meet CO2 reduction agreements in time, but many tenants distrust the home owners, want better maintenance first and show a “not in my backyard” attitude when they are asked to agree with proposed plans. Lack of communication about expectations, late involvement in the design process and lack of insight in the nature of energy related behaviour are some of the reasons why the policies to meet ambitions on CO2 reduction in the housing sector are facing problems. Participation can be applied as a strategy towards more support for plans, towards improvement of the user aspects of designs and learning-by-doing bu occupants. Participation brings about intrinsic motivation, which is a key to energy adapted behaviour. Participation and behaviour are related to energy policies.

Problem definition

Support from citizens in general and tenants in particular is needed for meeting CO2 reduction ambitions. This support seems missing, both in terms of willingness to pay for measures and motivation to change behaviour towards reduction of energy consumption. Little knowledge is available about the reasons for this lack of support for energy policies and why behaviour does not match expectations.

METHOD

Participation and behaviour will be analysed in local situations, where occupants meet the housing association and the local authorities. The relationship between behaviour and energy consumption was studied by Guerra Santin (submitted), using data from the National Housing Quality Survey (in Dutch: KWR 2000, with n=15000). In 2008 and 2009 she also did a survey (n=324) on energy related characteristics in large urban development areas (Leidsche Rijn in Utrecht and Wateringse Veld in The Hague) and collected data about row-houses built in the period1996 – 2007. The results are used in this paper for deductive reasoning, meaning that not the data per se, but significant variables are used to explain complex relationships between behaviour and building characteristics. The insight in participation and behaviour is based on literature on social dilemmas (Kollock 1998), on motivation, self realisation and behaviour of people in groups (Gagné & Deci 2005) and the conditions for meaningful participation procedures (Kalk 2002, Jamison 1999). Insight in the practice of citizen participation developed during active involvement in community action: protest actions, co-operative design and creative happenings involving all kinds of target groups. The results of this action oriented research are qualitative. Based on that experience, the ladder of citizen participation is applied in the field of energy policy, with focus on what works and why.

RESULTS

Behaviour and energy consumption

Guerra Santin (submitted) studied the effect of household parameters on total energy use for heating, domestic hot water, cooking and household appliances. The parameters included life style, comfort preferences, education level, income level and many household characteristics, such as number of persons and age. All houses are delivered between 1996 and 2007. The energy performance requirements were tightened during this period, starting with the standard building performance (EPC =1,4) and improvement to EPC = 1,2, then 1,0 and now 0,8. It means that similar houses in the survey could be grouped along energy performance levels that correlate with different insulation levels and different installations for ventilation (mainly) and for heating and domestic hot water.

Guerra Santin shows that most respondents have the main room thermostat at 19-20 ^{o}C during heating periods. Most people turn the thermostat lower during sleeping hours or when not at home. The duration of having the thermostat at the high setpoint is the major variable of the energy consumption. It means that both the number of hours at home and the behavioural aspect of the high setpoint correlate significantly with the energy use. Age of occupants can be a parameter of hours spent at home, but then age is not the significant variable of energy consumption, but the duration of high heating setpoint. The master room thermostat is mostly located in the living room, meaning that heating of other rooms follow in a master-slave sequence. Permanent or selective use of heating in rooms other than the living room is a significant parameter. Also, the duration of heating at high setpoint explains the energy consumption better than the absolute level of the temperature: first, because the temperature level does not vary significantly and second, because selective use of heating may change the average temperature difference between indoors-outdoors not much. The type of thermostat is important: an automatic clock thermostat tends to be set at longer heating periods that a manual thermostat. Occupants with a manual thermostat may be more aware of the relationship between comfort en energy and also between ventilation and energy, and a manual thermostat could possibly act as an instrument for raising awareness on energy behaviour. An automatic thermostat gives better comfort, but increases the energy consumption.

An explaining variable is the number of rooms that are heated simultaneously. There is a dividing line between occupants that heat more rooms simultaneously or only at rare moments, when more comfort is required. Another important dividing line is between occupants that ventilate permanently or only occasionally, for instance by flushing during short periods. Studies by Hasselaar (2006) show that 40% of occupants in master bedrooms keep the windows or vents closed in the heating season, also during sleeping hours. This behaviour increases health risk, but reduces the energy consumption.

There is no reliable correlation between energy use and type of ventilation system. All ventilation systems are used almost permanently at the lowest setpoint, so the effect of heat recovery is small under conditions in practice. There are perception and comfort related reasons for this poor use (Hasselaar 2001): the fans often make noise that occupants avoid by turning down the fan speed and occupants prefer to open vents and windows instead. Also, when turning the system high, occupants perceive high electricity consumption for the fans, while the recovered heat from exhaust air is a poorly perceived effect. The recovered heat is transported into all rooms, while bedrooms need no extra heat according to quite some occupants. The living room is the most important checkpoint for indoor comfort and at high ventilation setpoint draught problems are more likely to occur.

Guerra Santin found no relationship between Energy Performance Coeffficient (EPC) and energy consumption, nor with the type of household or income level.

However, these significant variables do not explain more than 50% of all variations in energy consumption, meanig that the relationship between building and occupant parameters still remains a question. The effect of the efficiency of heating systems, infiltration, stand-by use, internal heat gains (especially in the living room annex kitchen, that influence the main thermostat) has not been studied yet. Important building parameters that were included in the study and that explain variation in energy use are the insulation level and the type of dwelling, in order of energy performance: detached houses, row houses, apartments in multi-family houses and the most energy friendly type is the maisonnette.

Discrepancy in theory and practice of building performance

Indicator 1

Period with thermostat at highest comfort level

(difference between manual and automatic clock-thermostat)

Indicator 2

Only living and kitchen heated or all rooms heated

Indicator 3

Ad hoc or permanent ventilation

= selective use of grates and windows or open most of the time

Reduction at start of EPC, since 1996

No clear reduction when tightened to EPC = 1,2 or 1,0 and 0,8

No significant difference for:

Heating system

Ventilation system

Orientation

Type of household
Income level

Differences in energy consumption for:
Building period (refers to insulation level and sealing?)
Number of rooms (= size of dwelling)
Type of dwelling: detached, apartment, row house, maisonnette
Use of bath tub
Open or closed kitchen

The results indicate that the influence of behaviour on energy use could be more the result of working hours, activities outside the house, heating and ventilation perception, than SES, cultural values, attitudes etc. However, the perception of policy makers and planners about energy efficiency is different: the EPC requirements supposedly lead to more energy efficiency. Is there discrepancy between what is built and what the occupants need?
In evaluation studies of low energy houses, including passive housing estates (Hasselaar 2008), the use of technology depends on the quality of the design, of collective maintenance, of the role of neighbourhood experts (green neighbour). User needs are very different and not all needs can be included in designs, meaning that the perceived quality depends on the variety of interventions that are possible in different seasons, day- and night conditions, while being at home or away from home, in storm or rain or during periods with calm hot weather etc. Most ventilation and heat control systems are designed for winter conditions, while with increasing insulation levels the heating season becomes shorter and interventions in indoor comfort levels without heating become more important. In passive houses the major control issue for occupants is to control overshoot of the indoor temperature, the second is to provide enough fresh air into the bedrooms. Designers focus on standards and will meet only the minimum required levels, while the occupants have other preferences and needs. The reason for this discrepancy can be found in how the housing market works and what little influence the users have on the design.

Housing associations recognize that people who are active in neighbourhood committees tend to have a green heart, meaning they are supporters of energy measures. But they need to be involved from an early stage: they must be acknowledged as so-called “originators” of new initiatives. These enthousiastic people are the ambassadors for other people, which gives them a crucial role in finding support for plans. At least 9% of the population can be labeled active supporters of green measures.

Occupants are of varied attitude, perception etc. People can be active or passive in the neighbourhod, pro or contra climate initiatives, trusting or distrusting the home owners etc. Each person requires a certain feedback, varying from seduction, support, power play to stimulation and positive interaction. Because behaviour induces parallel behaviour, the productive strategy is to find the positve and active people, create a network and stimulate this network to develop ideas and plans. This will lead to more results and better cooperation than adressing the people that want to be left alone.

When active people in the neighbourhood cooperate, they often ask for independent experts to support them in developing alternative proposals. Availability of solid experts who know how to communicate with both the users and the housing associations and authorities is crucial for succesful energy saving projects.

Activities that have nothing to do with energy and that improve the living conditions for instance by bringing some fun into the neighbourhood and that take people’s interest seriously, have positive influence on willingness to cooperate on energy plans.

Often, proposals for energy measures are too optimistic about the savings effect. The “Total cost of living-guarantee” that was launched by the National Tenant Association Woonbond and the Union of Social Housing Associations Aedes is one way to show that the calculations are trustworthy. This requires information on actual energy consumption and transparant calculations, with knowledge about what parameters influence energy consumption. Whether this guarantee has a rebound effect, meaning that users become more careless about energy use, is not clear. The main effect is greater care for the calculation of savings.

A relation was found between social interaction and the perception of the technical performance of low energy houses (Hasselaar 2008). With more positive interaction the perceived user friendliness or comfort level of technologies was higher. Positive social interaction by people who take active care for the neighbourhood is a condition for positive perception of neighbourhood quality. Neighbourhood quality is the cornerstone of perceived housing quality.

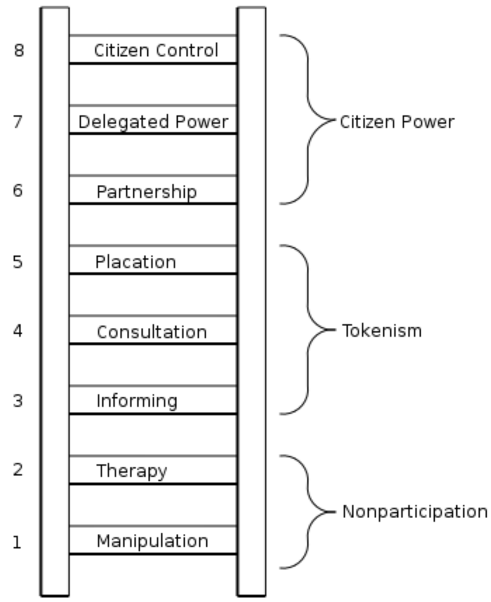
Ornetzeder et al (2001) found that user involvement in the design leads to more knowledge about the house, greater ability to use complex technologies and better acceptance of discrepancies of needs and what is delivered. This phenomenon presents a link between user oriented quality and participation. Participation is one way of learning-by-doing the proper use of building services, of input on user friendly designs and of solutions that meet the basic needs of households instead of (barely) meeting minimum standards. Participative planning can influence involvement in designs and in adaptation to housing conditions and vice-versa in achieving housing conditions that meet preferences.

Participative planning

Why
Meet diversity in needs
Failure cost when proposals are rejected
Improve communication and cooperation
70% support in social housing estate needed for energy measures

Participative planning can be defined as a planning process in which the (future) occupants express their ideas about their needs. Involvement can grow from communication to co-producing the design or the neighbourhood plan. Participative planning in the 1970’s was based on advocacy planning. It started as a protest movement against the decision to tear down urban areas, but was later part of a movement toward better local democracy. Citizens were supported by their advocates in getting better access to information and experts, they were helped with drawing up alternative plans and with forcing the decision makers to follow a more transparant decisionmaking process (Kalk 2002. This reflects a form of research which differs from mainstream housing surveys that focus on individuel needs. The practice matches Dewey’s conception of learning from experience: "…a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview… It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. " A fundamental premise of community-based action research is that it commences with an interest in the community, or an organization. Action research is not a ‘method’ for research but a series of commitments to observe and problematize through practice a series of principles for conducting social enquiry’. ('Action research', *the encyclopedia of informal education*, www.infed.org/research/b-actres.htm)

Levels of influence



To understand the different forms in which participation is presented, eight levels of participation are arranged in a ladder pattern with each level corresponding to the extent of citizens' power in determining the end product (Arnstein 1969). See Figure 1.
The bottom levels are (1) Manipulation and (2) Therapy. These levels represent "non-participation". Their objective is not to enable people to participate in planning, but to enable powerholders to "educate" or "cure" the participants. Level 3 and 4 allow the have-nots to hear and to have a voice: (3) Informing and (4) Consultation. When they are profiled by powerholders as the total extent of participation, citizens may indeed hear and be heard. But under these conditions they lack the power to insure that their views will be acknowledged.

Figure 1. Ladder of citizen participation (Arnstein 1969)

Level (5) Placation is simply a higher level tokenism because the ground rules allow have-nots to advise, but the powerholders continue their right to decide. Further up the ladder are levels of citizen power with increasing degrees of decision-making clout. Citizens can enter into a (6) Partnership that enables them to negotiate and engage in trade-offs with traditional power holders. At the topmost rungs, (7) Delegated Power and (8) Citizen Control, have-not citizens obtain the majority of decision-making seats, or full managerial power. Knowing these gradations makes it possible to cut through the hyperbole to understand the increasingly strident demands for participation from the have-nots as well as the gamut of confusing responses from the powerholders" (Arnstein 1969).

The practical use of the Ladder of Citizen participation
This Ladder is transformed into a ladder of participation in decisionmaking that involves energy policies and energy performance of dwellings. The ladder is used to place strategies of housing institutions and local governments who signed covenants for CO2 reduction levels and activities by occupants.

1. **Public Relations**: Presenting the green profile though pilots without succession, application of visible measures such as small (non effective) windmills, vegetation roofs etc is image building;
2. **Active and passive Communication** by professional experts: information campaigns that inform people about climate change, global CO2-emission reduction agreements and how to contribute to top-down energy policies by measures in the home environment (and in transportation) are ways to stimulate learning;
3. **Stimulation of initiatives**: the right to propose energy saving measures, Local Climate Festivals, Local Energy Covenants and other initiatives that stimulate interaction, but that in itself are no guarantee for influence. This leads to learning-by-doing;
4. **Facilitating projects**: providing expertise or subsidies for Energy Scans, support of local initiatives with facilities that volunteers need to get more people involved in local activitites. These activities allow active groups in the neighbourhood to move formward through action oriented research;
5. **Consultation**: ask reaction from neighbourhood committees on proposals or plans etc. The decisionmaker acknowledges the importamnce of target group input, but is free to do

whichever is appropriate with the advice. When consultation is rewarded, the intirnsic motivation may be destroyed by extrinsic prssure;
6. **Negotiation**: tenants and housing owners/associations exchange opinions, while the tenants have the right to obstruct proposals, because at least 70% of occupants have to support the plans. Negotiation that follows the famous Dutch “polder model” stimulates moving positions at both sides, which is crucial for social dynamics. Communication is level and with opportunity to discuss power inbalance;
7. **Cooperation**: participative development of energy plans, often including renovation of dwellings. Mutual support leads to user friendly output and at an ambition level in agreement with both parties. Cooperation is the key to local democracy;
8. **Co-production**: this can be found in ownership collectives (in Dutch VVE= Vereniging van eigenaren). There is collective interests in energy performance and shared tasks, responsibility and risks. Co-production requires much input by occupants. When this input is taken over by professional external experts, co-production stops and transforms into consultation.

When a housing association presents plans later than the moment when they decide that intervention is needed or even later, after having studied the possible measures, the tenants may perceive this involvement as coming too late. Practice shows that the cost of failure of this strategy is high and creates distrust, which may take years to recover and more plans plans ignored by the tenants, before the housing association decides to bring the participation process two steps higher, from consultation to participative planning. Many field studies show that cooperation is a successful stategy to gain support from tenants. Also, studies of co-production (cooperative housing) indicate that success goes beyond good plans: it also changes the community and the attitude of households in the project. Cooperative planning leads to higher priority for the quality of semi public spaces, leads to higher sustainable ambitions and the learning process changes the behaviour of involved households, resulting in a smaller ecological footprint. For many of these people the focus on low energy consumption of dwellings is just one of the many ways to save the planet. Dutch examples of (different levels of) cooperative planning are Groene Dak at Utrecht, Ecodus at Delft, EVA-Lanxmeer at Culemborg, Waterspin and Vormidabel at The Hague.

Behaviour induces parallel behaviour by others. Giving a positive example is the fist step towards cooperation. People can change their behaviour but this cannot be changed by others. This is an essential principle of participation. Respect for different opinions and level communication about strategies and measures is the key to succes in energy policy execution. Effective strategies involve positive people who are socially active and want to cooperate to make the city or neighbourhood a better place to live in. These principles are recognised in the so called Asset-Based Community Development [ABCD], that typically shares its findings on capacity-building in community development through interactions with community builders and by producing practical resources and tools to identify, nurture and mobilize neighborhood assets. The work involves nonprofit research, policy development and education with pioneering in all aspects of recycling, solar technology, and ecological housekeeping. ABCD also advocates a new civic agenda to create communities that work for everyone and promotes the principles of collaborative problem-solving and consensus-based decision making. Communities are helped to design and implement innovative strategies that enhance the local economy as well as the local environment and quality of life. ABCD focuses on partnership (level 6 of the Ladder of influence).

Many projects reflect these positive principles. A selection of initiatives on level 6 and 7 of the ladder of citizen participation are:
-Green neighbour (active and expert citizen giving personal support to the neighbourhood);
-Climate festival (creative idea generation process (www.woonbond.nl: klimaatfestijn)
-Helpdesk for information on sustainability issues (local government, housing association)
-Design workshops: participative development of plans for CO2 reduction in housing

-Mobile energy office: a bus visits the neighbourhood for consultation, inspection and generation of energy advice (www.Woonbond.nl, accessed 2009);
-Energy boxes: free or low-cost materials that cut the energy bill: refelective foil, Led-lights.

The Climate Festival, which is based on the Idea Brewery (www.ideeenbrouwerij.nu), generates local ideas on how to improve the sustainable quality, both in the public and the private sphere, and facilitates the stepping stones: from idea generation to local action (from the slogan "Think Global, act Local"). The Idea brewery uses a creative workshop strategy to stimulate new initiatives. The step-by-step protocol of a group session is:

- Write down individual ideas
- Present the ideas to others in a subgroup of 4-8 people
- Present the ideas in a plenary session, clarify and add new ideas.
- Select priorities, discuss and decide on the best idea
- For each best idea, identify a coach who will encourage people to take action

Then follows the execution phase: facilitating, communication, co-production
The Idea Brewery is repeated once or twice a year and starts with an illustrated report on all ongoing projects that resulted from the previous Idea Breweries. In Gouda this report is called the "happy city merry-go-round", because of its positive impact and inspiration.

DISCUSSION

A new approach to energy conscious design
Energy campaigns and calculations of savings are based on steady state conditions, on averages, on quite conservative households who spill energy, because they are supposedly unaware of energy saving strategies. Also, the information to consumers is dominated by commercial parties, who proclaim that their product is good for this much energy savings. Example 1. A manufacturer of heat recovery ventilation units claims savings of 400 m3 of natural gas per year. This is true on the basis of calculations and optimal use, but in practice the effect is more likely less than 25% of this claim. Example 2. Automatic clock room thermostats are still proclaimed as energy saving measure, however, with a new sound telling "only if you tend to forget to turn your manual thermostat down ( ). Example 3. A tricky advise is: Do not turn your thermostat down during the night, because re-heating the house will take as much energy as would be needed to keep the house at a constant temperature. Example 4. Turning the temperature 1 degree lower in the daytime will save 7% energy. How about tips for people who are very aware of energy consumption? How to give advice for those who already took many actions and use little fossil fuel in houses that are not at all energy efficient. Why no more focus on electricity? Electrical power for domestic use creates more CO_2 emission than the use of natural gas. What tips can be given to occupants of low energy houses or passive houses?

The strategy for CO_2 reduction in dwellings with energy-conscious occupants

First we transform the "trias energetica" into a four step strategy:
1. reduce energy demand
2. apply sustainable energy
3. use energy efficiënt techniques
4. support the user in energy efficiënt control

The fourth step involves the user as an actor who takes control over the indoor climate by smart use of control techniques.

Based on a study by Itard (2008) insulation has the best effect on overall sustainable performance of a dwelling, because of its low embodied energy, the long life span without maintenance and the great effect on energy performance. Good insulation, however, has more positive effects: the temperature without heating increases, due to solar gain and indoor heat sources. In well insulated houses, the winter becomes shorter. Also, the heating demand period per day will be shorter, while a few hours of solar gain will avoid the need of extra heating. In the Ecobuild Research project, a low energy house would only require heat in the early morning and from late in the afternoon until (near) bedtime, on sunny days and irrespective of cold temperatures (except for extreme low levels). What would happen if the users would be able to bridge the period between getting up (say 7.00 o'çlock) and the heating by the sun without turning the heater on? This would result in efficient use of solar gains.

Also, when occupants turn the heater a little higher when they feel cold, they would probably demand less heat than with an automatic clock thermostat that delivers a comfort temperature that is set to an overall acceptable level of 21 or 23 ^{0}C. An important behviour pattern is: turn up the thermostat when you are cold and as much higher as is needed (for some time) to feel comfortable. This does not need to be 17 or 19 or 23 or 25 ^{0}C. The stepwise increase can start at the actual temperature: the thermostat could be raised from 13 tot 17^{0}C, only higher some hour(s) later.

Individual thermostatic valves in each room.

Considering that in average houses with central heating a central room thermostat, the other valves are slave of the master control thermostat. This points at the influence of heat sources in the living room: with internal heat, the room thermostat will not start the heating system and bedrooms will not be heated. This is a key factor of efficient heating. It poses the question how electricity use and gas use are related. This goes for the living room with the central thermostat.

Solar gain preferably in rooms that are used during the day, or the other way around.
Heat sources that cannot be avoided preferably where useful: the boiler and heater connected to the bathroom.

Open type kitchen, to enjoy heat gains from cooking. Extra exhaust system while cooking, not connected to the HRV.

Refrigerator in a cool place,

Ventilation is in the first place a service to provide good air quality, but it is also a means to control the temperature. The traditional approach to energy losses through ventilation is to calculate the ventilation flow and the heat demanded to bring fresh air to indoor temperature. When manufacturers (of Heat Recovery Ventilation or HRV) consider all ventilation air to be serviced by the HRV system and at permanent standardized volume and also consider all heat to be provided by the heating system, then indeed 400 m3 of natural gas will be saved. In practice, systems are used at low volume, with only short intervals and high (=standard) volume, while a substantial amount of heat comes, especially in well insulated houses, from other sources than heaters. The modern approach to heat losses through ventilation is to ventilate the house while asleep or while away and reduce the ventilation when heating the house, until pollution levels require demand controlled extra ventilation. It means that when occupants come home or get up and want more heat, the air temperature is not relevant, but the radiant temperature, especially the availability of a heat source at a place where people sit and eat or read or socialize or watch tv. Radiant low temperature heat surfaces with low indoor air temperature provide a comfortable and energy efficient heating system. Guerra Santin found that the number of hours that a heating system is used, is a good predictor of total energy consumption. The temperature level and also the ventilation system did not explain the variation in energy consumption. It is possible to design and apply a heating and ventilation system that is easy adaptable to the individual demands, that is fast reacting to ad hoc needs and fits the life style of so many people, who occupay the home for short periods per day, or at least nees extra heat only during short periods a day. Infrared radiation serves the purpose of this type of heating. Infrared heating can be provided by well selected incandescent light bulbs. Why use a central heating system in a study when a 250 W flood lighter can provide comfort, always during a period when good lighting is needed as well? Here lies a secret for energy saving: this local and even individual climate control avoids the need to turn the central heating on and this really has effect on the energy consumption.

Comfort perception is the key to the indoor climate. Comfort parameters are: air temperature, radiant temperature and asymmetry, relative humidity and air velocity around the ankles and neck. The feet must be warm, not the head. This points at the importance of floor insulation, and the potential good effect of reflective foil pillows under the floor.

The cooler the air, the better perceived as fresh air. The moisture content has great impact on the heating demand of air. The cooler and dryer the air, the more energy efficient climate systems can function. Polluted air is often perceived as too dry, because of the irritating effect. It means that for health and also energy saving purposes, air must be clean. The question remains if clean dry air (lower than 25%RH) has a negative effect on health and comfort. If that is the case, both the temperature and the fresh air volume could be reduced, to improve the perceived quality. Moisture production can correct the RH, as long as it does not influence the pollution level (moisture production not via laundry drying, cooking, while potted plants may have negative effects on air quality).

Energy companies apply a seasonal correction factor to the degree day based energy calculations. During the winter time (November through February) the factor is 1,1 and in the summer(April through September) the correction factor is 0,8. Though different interpretations are given for this factor (density of natural gas, effect of wind on perceived temperature, heating effect), the heating effect is probably relevant: when it is colder than 18 ^{0}C in the winter, occupants are likely to heat the house, while they will not use the heating system during (short) periods in the summer below 18 ^{0}C. Also, cold winter wind is more likely to cause comfort problems through draught, which will cause extra heating demand. This effect points at the importance of good sealing of the envelope.
Very cold winters have less effect on energy consumption than the degree days would suggest. This could be for three reasons: 1) the occupants demand lower indoor temperatures, because the heaters will be on and provide warm radiance, even with low air temperatures, 2) the heaters have a higher efficiency because of lower standstill losses and low return temperatures and 3) occupants adapt clothing and needs to the outdoor conditions, with a delay of about four days (Brager and DeDear), meaning that the temperature needs are lower in a prolonged cold period. This leads to a preference for temperature differences in a dwelling, that promote the body awareness of temperature levels and of comfort areas.

Compartmentalize
Many occupants prefer a cool bedroom, a very warm bathroom and temperatures in the living that can be adjusted to the activity level, the type of day etc. Meeting this preference with the design of the houses is a stepping stone towards energy efficient housing. This approach differs from the strategy of passive houses, where the envelope is well insulated and the indoor climate is like a well stirred vessel, with small temperature differences.
Well ventilated houses and cold bedrooms do not point at high energy consumption. Analysis of user profiles suggests that awareness of heat losses from the bedroom floor promotes selective use of heating in the living room, possibly with lower average temperatures. This doen by no menas suggest that these occupants suffer from the cold: when their comfort

needs elate to short periods of "quality time", they may enjoy good comfort with low energy use.
The parameters from previous paragraph do not include the features that are considered crucial for good energy performance, except for the insulation level. Heating system parameters were included, but not the efficiency of the heater itself, nor the ventilation system. The efficiency of these systems will have effect, but as a secondary influence, the more important paramater being the period of time that a heater is called to function by the occupants.

A heater will have about 1000 working hours per year, plus only 100 hours (at maximum capacity) for domestic hot water production. An important feature of the efficiency is the use of energy at standstill: pilot flame, heat losses of a boiler, circulation pump, electronic controls. Then follows the heating efficiency, but the question is whether 10% better efficiency will reduce the heating energy demand with 10%: it should be, it may be only a fraction lower.

Hot water
In low energy houses the domestic hot water consumption equals the heating demand. The efficiency is important, next to the number of showers and the duration of one shower. Behaviour will influence this pattern much. With many showers a solar domestic hot water system (SDHW-system) will be a sustainable measure: a SDHW-system can produce up to 50% of the energy demand for domestic hot water.

Heat pumps
Heat pumps have a low life span and need electricity. This combination results in a poor sustainable performance over the total life cycle of the product. The application is only interesting when working on sustainable electricity.

Heat recovery ventilation provides a modest contribution to the sustainable performance of a dwelling. The extra electricity use, the investment in materials and maintenance and also the potential health impacts make this option not very effective. However, for the coldest winter period this HRV provides both good comfort and energy savings. Also, in combination with after-heating of the air ducted into the living and bathroom (optional also to the bedrooms), this system can avoid major parts of the heating system. The passive house concept will improve the sustainable performance, when the heating and ventilation system are integrated.

Table presents the new paradigm of energy efficient dwellings

High insulation level	**User profiles**	**Comfort perception**	**Climate control**	**Technical systems**

Resulting temperature without heating (solar gains) Temperature fluctuation and gradient.	Short length of user periods. Needs differ: early morning, daytime, evening, night time. Condition.	Adaption to outdoor conditions. Physical activity. Clothing. Personal needs.	Personalised control per room. Cool air in bedrooms. Adaptation of dwelling to seasons.	Warm spots Radiant heating. Manual thermostats. Local heat supply. Continous basic ventilation plus local ventilation. Summer natural, winter HRV. Flexible infrared heat sources.

The concept for the house according to the new energy paradigm

Flexible layout
Compact and smallest (winter) area very well insulated and with proper sealing

Natural ventilation in summer, based on new types of inlet and outlet systems for cool seasons and summer.

Heating and HRV integrated for the winter period

Simple small combined heater for DHW and individual heaters in fresh air stream.
Potential SDHW system
PV preferred for electrical appliances: minimum of 5 m2, up to 20 m2

Adjustable air volumes per room, more capacity than ventilation standards require.

Natural ventilation in summer: use of shafts , roof windows and cross ventilation to ventilate and cool th dwelling (not ducts). New type of inlet openings.

Summer and winter compartments, either by sunroom or sliding wall.

Bedrooms as flexible sleeping dorms connected to the façade: cool sleeping in the outdoor environment, local climate control for the winter, using HRV

Extra radiant heat surfaces

Ground duct for cooling?? Too complex

Sun shading

Natural light: good distribution, high light (roof, ceiling, shaft for lighting and ventilation)

Invloed van interne bronnen in de woonkamer

De rol van thermostaten en thermostaatkranen
Het gasverbruik is afhankelijk van een groot aantal factoren:

Hoeveel kuub is je huis?
de instelling van je thermostaat
toepassing van nachtverlaging
hoe laat verlaag je de temperatuur?
hoe laat start je de verwarming?
verwarm je ook de slaapkamers?
is er een open trap, waardoor de warmte naar boven kan stijgen?
heb je vloerverwarming?
Zijn de cv-leidingen in niet gebruikte ruimtes geisoleerd?
hoe hoog is de ingestelde maximum temperatuur van je HR-ketel?

Start of heating period is important
Winter season
Daily, when comfort temperature is too low
Behaviour change toward delay of turning up thermostat
Sleeping in cool bedrooms that can be ventilated
Well controlled ventilation in living room annex kitchen
Permanent basic level
Natural as long as possible, fan support when needed
Electricity use is life style dependent
Verwy well insulated dwellings (hybrid passive house)
Participation brings notions of self-esteem, identification and control. Participation creates interest, interest improves the use of knowledge and inherited knowledge leads to change in behaviour. The keys to this process are learning-by-doing, intrinsic motivation and empowerment.

Positive perception of housing quality leads to better acceptance of the technology of the house, better ability to learn how to control systems and more willingness to keep up the maintenance level. This chain of cause and effect is believed to work vice versa, meaning that poor housing quality, poor maintenance and lack of personal attention may lead to poor use and maintenance of crucial technologies such as ventilation, and will in the end lead to social disintegration of a neighbourhood.

Certain user groups, for example (political or economical) refugees, can be insecure about their status and therefore can be more suspicious of other people's intentions. This may become a barrier for social interaction and for learning how to appreciate a house or how to use its systems. Much energy is needed to change this perception. Technical oriented housing managers tend to feel awkward towards handling social processes and avoid horizontal communication and participative management (Hasselaar 2008).

Succesfull participation meets the following conditions (Kalk 2002): a. discussion is possible about the goals and strategies of the planning process; b. all information that is needed in the planning process is available to all participants, and translated for non-specialists to make information accessible; c. users and non-specialists have the right of independent professional guidance (a moderator in the team); and d. the procedure is organised in phases with fixed moments of decision making, while decision makers motivate non-compliance with the proposals of participants. An architect can cooperate face-to-face with the tenants in a series of workshops on location studies, the functional plan, details of materials and installations and cost consequences. The architect translates ideas of participants and reports to the owner. The owner is responsible for final decisions and negotiates with contractors.

A participative design process recognises different steps, types of involvement and methods. See Table 1.

Design model based on user participation

steps	**involvement**	**methods**
1. collect information	Introduction of experts by neighbourhood representative	Checklist for problem identification
2. social map, housing needs	Face-to-face meeting	Semi-open questionnaire, focus groups
3. stakeholder agreement on procedure	Input into social contract: relocation rules, time schedule, representation, moderator support and open access to meetings Open access, invitation to get involved, direct input of ideas, learning process	Acknowledgemetn of conditions for user participation, negotiation, results communicated via web, journal, leaflet
4. design process	Steps: area plan, envelope, technical systems, lay out, details, decorations, rent level	Teamwork and accessible information. Select installations to be tested for user friendliness, perform pilot renovation
5. benchmarking	Evaluation, calculations	Benchmark tools, questionnaires, focus groups
6. final plan, rent increase, relocation options	Local community is independent controller of outcome, feedback on results is possible, go-no go by team	Apply rules of how input of occupants is rewarded and reviewed, double-check by independent experts. Results available via website and leaflet.
7. individual decisions per household: deals	Individual deals	House-to-house visits, fixed dates for execution, fixed plan, rent, subsidies, support in relocation
8. execution	Social support when moving out, personal tour at delivery	Direct communication between occupants and project leader
9. (re-)use	Do-it-yourself task,	Social team, green neighbour
10. post-occupancy evaluation	Independent evaluation, results open to all for feedback	Focus group meeting, brochure, party and ceremony

Table 1. Participative design model for high performance energy-renovation plans

CONCLUSIONS

Positive activists are green and democratic
Examples are followed: green neighbour
Bottom up initiatives improve quality of cities and neighbourhoods
From stimulation and facilitating to cooperation and coproduction

Effect of participation
At project level
Successful decisionmaking process in short period of time
Getting 70% support was easy
Clear information exchange on plans and processes
Construction companies and providers interact with occupants

General effects
Users not as social problem but partners in change
Positive orientation (integration, sustainability)
“polderen

STARTICIPATION

The energy performance of housing is an important policy issue. The importance of behaviour is recognised as an important factor to reach ambitious goals: behaviour can support CO2 reduction ambitions at low investment levels, while physical improvements need high investments and have lower cost-benefit ratios.
Calculated effects are often not reached because occupant behaviour differs from modelled behaviour. The role of users is important, but poorly adapted behaviour cannot be waved off as “responsibility of the user”.
So called “fair” procedures have a positive effect on cooperation, because it enhances the process of self-other merging between the group authority and the group members.
Participation leads to greater awareness of the importance of eco-conscious behaviour and of how to handle installations and other technologies of the house. Learning how to use a product is part of the use process and this learning is influenced by the user as well as the ‘learnability’ of the product. Involvement of users in the design process is one way of learning. Direct user tests are possible through testing of pilot houses as realistic prototypes of new products, or via evaluation of existing projects. Participative design will lead to more user friendliness and better response to housing needs. In the exploitation phase it is important to guarantee good communication and fast response when problems occur.
Social interaction works when the organisation or individuals give a good example. Projects that are initiated in an arena where top down support is available for bottom up initiatives, have better chance of success. “Small” initiatives are the stepping stone for cooperation on larger housing issues and finally for co-production of the neighbourhood and the city.
Involvement is needed from the start, meaning that in most housing estates this proces of stimulating initiatives and improve communication can start today.

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Voorbeeldmateriaal

Citation

Cite references in the text by name and year in parentheses. Some examples:

- Negotiation research spans many disciplines (Thompson 1990).

- This result was later contradicted (Becker and Seligman 1996).

- This effect has been widely studied (Abbott 1991; Barakat et al. 1995; Kelso and Smith 1998; Medvec et al. 1993).

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