Sustainable buildings in Poland – State of the Art

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1 Introduction

Sustainability can be introduced by special means of country's or regional policies. These means may have different form:

- legal
- organisational
- financial
- fiscal
- educational
- other

All of above means are finally focusing on creation of willingness to pay (WTP) for sustainable investment, as this is investment that develops sustainability. The WTP as seen by economy is interpreted in cost and profit language where the discount rate is a main factor for taking the investment decision. It is reported, [1, Sutherland] in relation to energy conservation investment, that WTP depends on market value of available rates and it accepts lower than market rate with increase of investor financial wealth's. The neoliberal economists say that political intervention into economy causes market failures. Market forces are belived to take into account and enforce the need for sustainable environment themselves, if we do not disturb the supply–demand interaction.

This could be a general true, provided that the value of products on a market (as opposed to market value) reflects all of related environmental costs. Due to the competition most of the producers do not count enviromental costs into the final product's price, because quality of environment is still considered as a limitless good for individual enterpreneur, even if it is not true for global macroeconomic balance.

This article discusses some aspects of WTP based on experiences of two different ways of introducing the sustainability into Polish market. The first one comes from legal category, where the adequate act of law has been accepted to support WTP for modernisation of existing buildings, and the second one is a international demo project which used subsidizing for backing up the GHG reduction investments.

So far, both of them did not developed enough to bring predicted results. Both of them failed to propose enough to create expected WTP of investors. The opposite experience is reported from summaries of EU RTD Vth Framework programme, where the WTP has been triggered by 1/3 of the support given to the investors.

The explanation and analysis of this fact could be very comprehensive, inhere we try to find a simple correlation between WTP and an overall Environmental Sustainability Index as it is

defined by An Initiative of the Global Leaders for tomorrow Environment Task Force, World Economic Forum. [2].

For beter understanding of programmes recently developed in Poland it would be helpful to present the overall situation of Polish building sector.

2 Background - basic information about housing in Poland.

According to 2001 data Poland has approx.. 12 million housing units with the total usable space of aproximately 710 million m^2. The age breakdowns are as follows:

- before 1918 - 1.44 mln apartments,
- (1918-1945) – 2.28 mln,
- (1945-1960) – 1.50 mln,
- (1960-1970) – 1.91 mln,
- (1970-1996) – 2.28 mln,
- (1997-2001) – 0.5 mln.

Most of the building stock has been erected in an industrial prefabricated technology of poor quality. Today state owns only 0.3 mln out of 12 mln. stock, over 42% is strictly private, remaining part belongs to housing communities (self-government) and housing co-operatives.

Average energy consumption structure by residential buildings is as follows:

- heating and ventilation 71%,
- domestic hot water – 13%,
- kitchen – 9%,
- lighting and electric appliances – 7%,
- others – 0.5%,
- data according to [3, Monitoring...].

Approximate seasonal heat demand indicator E, relative to periods of different effective standards is within a range of 350 – 90 kWh/(m^2 K). The latter construction the lower consumption. Differences in values of (E) indicator are related to the periods when respective standards for construction of new residential buildings were effective. The table 1 represents permissible values of heat transfer coefficient U [W/m^2K] relative to the type of the wall, and the periods when each of the of standards was in effect.

Type of wall	**U max [W/ m^2K]**				
	PN-57	**PN-64**	**PN-74**	**PN-82**	**PN-91**
external wall	1,16	1,16	1,16	0,75	0,55-0,7
Roof	0,87	0,87	0,7	0,45	0,3
Garret	1,05	1,16	0,93	0,4	0,3
Windows	n/a	n/a	n/a	2,0 IV, V 2,6 I, II, III	2,0 IV, V 2,6 I, II, III

The directive of the Ministry of Internal Affairs and Administration, effective as of 30 September, 1997 provides for energy consumption requirements relative to buildings in accordance with the following formula:

Value E_0 kWh/m^3a	**Value A/V**
29	<=0.20 (compact building)
26.6 + 12 A/V	0.20 < A/V < 0.90

37.4 kWh/m^3a	>= 0.90 (wide building)

where:

E_0 – seasonal heat demand for space heating purpose during a standard heating season relative to usable area of the building that requires heating. (the value of the indicator is a function, primarily, of location and technical wear of the shell and may help assess energy efficiency of the construction technology used),

A - external wall area,

V - overall volume (cubic meters) of heated portions of the building.

Typical building envelope before 1945 has thick (76cm) walls of brick with no thermal insulation. Typical external walls from '50-ties and early '60-ties were 51cm or 38cm thick brick walls, and still no insulation. In late '60ties prefabrication was vastly introduced. From that time on, the thermal insulation (layer of air or mineral wool) was applied. '70-ties were dominated by large format prefabricated concrete walls of mass production. Corresponding legal requirements for wall performance were initially descriptive. Now designers are obliged to calculate annual energy demand (E). Nowadays, improved traditional technology is applied in most residential buildings, both detached or townhouses,and typical 4-storey multi-unit ones. Three or two-layer, plastered ceramic wall is typical with mineral wool or styrofoam or extruded polystyrene and vapour barrier insulation. Recently we may observe shift towards cheaper and simpler two-layer walls.

The scale of recent construction in Poland is far below the needs and reaches approx. 80 thousand units per year. In order to achieve by the year 2020 average European of 400 units per 1000 inhabitants, 280 thousands apartments should be constructed per year. The significant factor is an increase of average apartment area from 60 m^2 several years ago to 90 nowadays. Also the tendency of high rise construction is shifted to the 4 and less story houses, 64% of constructed residential buildings have less then 4 floors. Among them 78,2 % are traditionally built, 11.8% are monolithic concrete structure and the remaining 6.6% are large format prefabrication.

Considering the cited data it is obvious that thermal modernisation of existing buildings and modernisation of their systems to reduce energy and water consumption is most urgent. However, there is a strong need for new housing in Poland (there are approx.200 flats per 1000 people), so it should be expected that sooner or later it will result in intense construction activity, which will highlight existing problems with waste management. On the other hand, there is a chance to balance housing deficiency with new, sustainable buildings. To help to overcome problems of modernisation of building stock, Polish government introduced special financial mechanism to improve the investors' ability to undertake the sustainale investments.

What is important in this section is that Poland requires both modernization of existing building stock and well prepared plan for new sustainable houses that are demanded.

3 The Thermomodernisation Act

Issues of energy efficiency and thermomodernisation are the sine qua non conditions of sustainability. They are strictly connected with economics, and their execution can be immediately discounted. Therefore, for countries in transition, they gain a top priority over the sustainability and environment themselves.

Thermomodernisation Act established by parliament of December 1998, with latter amendments in July 2001, called into being the Thermomodernisation Fund. The Fund is an institution financing – in form of thermal modernisation bonus – the projects aimed at the improvement of buildings envelope, internal technical systems, local energy sources and

distribution networks. After fulfilling terms of the Act, the investor using bank credit for thermomodernisation is granted a bonus. The bonus may reach up to 25% of the credit raised for the investment, and is paid , by the Fund, to the bank servicing the credit after finishing construction process (previous version of Act, set up the bonus release after repayment of 75% of the credit with the regular interest rate).. It means that the cost of investment is significantly decreased.

The premium is paid only for measures which fulfil condition concerning level of profits, the type of modernisation activities and its economic result, the conditions of the investments eligible for funding are:

- yearly energy saving should be bigger then 10 % of the total heat use, if only heating system inside the building is modernised, 15% (if the heating system was already modernised in the given building) or at least 25 % in other cases
- yearly energy savings at least 25% of annual heat loss of primary energy in local heat source and local heating network
- execution of connection to centralised heat sources of energy if, in result of liquidation yearly savings of heat supply costs are bigger then 20% of the total heat use
- replacement of conventional sources of energy by non-conventional ones.

The other Act requirements are:

- coefficient of heat resistance of the modernised envelope cannot be lower the 4 m^2K/W,
- repayment instalment (which is total of capita rate and interest) must be paid from savings,
- permissible payment period cannot be longer then ten years,
- maximum credit amount cannot be bigger the 80 % of investment cost.
- presentation the energy audit of specific scope and the form regulated by the secondary legislation

The bonus may be granted to the owners or administrators of housing buildings, buildings of housing co-operatives, buildings used by local self-government for public purposes as well as administrators of local heating networks and sources.

The introduction of the Act and the whole financing scheme resulted in a period of 1999-2001 (August) in 543 applications and related investments on amount of 60.2 mln. zł (1 euro = 3.6 zł) Positive decisions on granting the bonus concerned 395 applications on amount of investment of 44.2 mln. zł. Total value of bonuses granted from the beginning of the programme is 8.9 mln. zł far less the predicted potential. The programme of support termomodernisation interest showed moderate investor's interest. However, it is a first programme implementing in a direct manner the State policy in relation to the existing housing stock. The fact that it is implemented prior to the process of support of revitalisation of housing stock with use of public funds shows that the policy of energy conservation has a top priority. It is foreseen that the next regulations will cover issues of the whole energy and water usage, along with waste management including construction process and recykling.

The programme development has been criticised by different groups. Financial resources every year dedicated for the Fund remained not spent. This can be explained by different barriers related to thermomodernisation, one of them is poor attractiveness of offered support from investor's point of view. This results in investors's hesitation to undertake the investment. However, in other countries programmes less supportive are gaining higher interest. This interest is connected with WTP (willingness to pay), and in case of Poland it shows different priorities of investors. These priorities are related to economical, social, environmental and educational situation of the country, partly explained by the correlation of elements of ESI – environmental sustainability index.

The programme of thermomodernisation is dealing with existing buildings, whereas the improvement of building standards over the ones in power is a scope of the project undertaken by Global Environmental Facility and related to the new construction. The next point describes experiences gained during the execution of GEF project in Poland.

4 Global Environmental Facility Project

4.1 Introduction

In a five year period (1997-2002) over 10 new-built housing projects in Poland underwent the process arranged by Global Environmental Facility (GEF) demonstration project - the Energy Efficiency in Buildings component [4, Sustainable ...]. GEF project was tailored to specific needs of Polish housing construction given the name of Energy Efficiency Fund for New Residential Buildings. The resulting arrangement was as follows:

- The EE Fund would grant-finance 100% of incremental energy efficiency and conservation measures, i.e.: extra improvement above the current Polish building code.
- The EE Fund would be provided to applicants who have secured construction financing
- Environment Bank (BOS) would market the project and manage granting procedures.
- National Energy Conservation Agency would audit projects in sense of their energy optimisation and monitoring results.

4.2 Environmental performance and cost effectiveness of the project

One of the strict requirements to be met by granted projects was cost-effectiveness of extra features. That means, the cost per unit of conserved energy had to be lower then cost per unit of electric energy on the market. Given that, several extra features were successfully applied in new designs. The most efficient of them are:

- an additional insulation of walls, roof and basement floor, above that required by Polish regulations combined with high thermal efficient windows and doors
- mechanical ventilation system with waste heat recovery
- passive energy collecting features incl. solar energy and recovery of waste heat from technical systems

Detailed energy audits revealed very promising energy savings (up to 90%+ for the combined systems) and reasonable incremental cost efficiency.

Investors applying for the EE grant were to undergo complicated and time-consuming process of auditing construction projects, accepting applications by GEF Project office, co-operating with auditors and supervisors. What's more, it was the investor's financial risk, since it was the investor who was to secure all the construction costs including incremental cost of energy-conserving extra features before grant was paid after successful completion of recommended measures.

Considering GEF Project through PPP (place, product, price) principles of marketing we can identify some of its barriers. The product here is the environmental performance of building successfully achieved in over 10 realised projects, so we take this variable as constant value while the other two – place and price are subject to further manipulation.

Price needs some comment. As it was said before, the grant was paid **after** the completion of construction. For that reason no cost of money was considered in the cost-effectiveness of the energy measures. This is an important factor in face of economical facts in Poland, where the interest rates oscillated at figure of 25% at that time. The cost of money was paid by investors, but it was paid along with energy audit, and both should be somehow additionally included in the grant e.g. as a part of incremental costs.

"Place" is most controversial. It seems that programme could be better disseminated. As a result of the lack of information many potential investors were unable to undergo the procedures required by GEF Project Office in a time, even if they were able to provide extra money for incremental initial cost. The predicted high interest of investors caused that the programme designers had not reserved resources to market the programme.

Table 1: Costs and Benefits of the 2 Groups of Energy Efficiency Strategies

Unit type	Energy savings	Incremental Construction Cost (GEF Grant)	Cost of Conserved Energy	Simple Payback[1]	GEF Cost-effectiveness
	%	PLN/m^2	(CCE)[2]	Years	USD/ton CO_2
Group 1: Improved Insulation and Windows – Averages for 4 Projects					
Townhouse	27 – 34 %	14 - 31	0.054 - 0.083	2.2 – 3.3	19 - 26
Multi-family	21 – 32 %	17.1 – 23.1	0,136	2.6 - 5.4	15 - 81
Group 2: Mechanical Ventilation, Waste Heat Recovery, and Controls, plus Improved Insulation and Windows – Averages for 5 Projects					
Townhouse	68 - 75 %	148	0,185	6.3 – 7.7	42 – 45
Multi-family	63 – 77 %	75.9 – 98	0.1 –0.144	4.6 – 6.7	76 – 130

1 Using the national cost of electricity as the base (from 0.18 – 0.2088 PLN/kWh, depending on year of analysis).

2 Where CCE = (D Cost / D Energy) x (discount rate / (1 – (1 + discount rate)–n)), where discount rate = 0.12, and n = 50 years.

4.3 Were the main goals of the GEF Project achieved?

EE Fund for New Residences objectives were:

- implementation of a pilot program for energy efficiency in new residential buildings
- gain of practical experience to be attained
- initiation of placing up the housing energy efficiency equipment in local markets

We can measure main goals of the project by two indicators of achievements: the quality of experience and the scale of it. The quality of experience means effectiveness of dissemination of technical and organisational solutions, while the scale of the programme means recorded repeatability of implemented ways of development countrywide. Taking this definition as a basis we can conclude that the EE project did not perform in a predicted way. The obstacles of project development can be categorised as limited:

- capacity of investors to absorb the money (high initial cost is essential)
- ability to advertise the programme
- ability to effectively manage the process in a given time

The programme did not attempt directly to help investors to overcome the barrier of higher initial cost, but their willingness to pay (WTP) was enforced by expected refunding, despite the risk that they would not comply with final requirements of detailed procedure due in time and sophisticated technology.

GEF project supported several real investments which will form a reference for the future developments of sustainable housing in Poland, despite of its poor performance in reaching all of founders' goals.

5 the Vth Framework

Described above, two financial mechanisms have failed to fulfill their objectives. Thermomodernisation Fund and GEF did not attract expected interest of investors despite the pedicted financial attractiveness. Within a Fifth Framework RTD European programme financial mechanism which facilitated implementation of demonstration projects of new technologies, approaches and solutions under the thematic programmes existed. This mechanism was based on a rule where up to 35% of incremental costs could have been refunded by EU. A number of projects underwent this procedure, and according to reports summarizing Vth Framework the proposed mechanisms has been widely accepted and used among the European Communities member countries. This means that remaining 65% of money invested by the applicants came from other private or governmental sources. The overall tendency is the increasing direct financial participation of investors. This could lead into the conclusion that the WTP of investors from countries of European Communities is at least as much as 65% of marginal costs for new technologies, even if the market value of the investment in energy saving measures is far below the interest rates.

6 Conclusions

The WTP is a complex factor and depends on level of income (GDP), education of society, traditions, externalities (meant as the characteristic of local environment), health, and many other social and technical aspects. The WTP reflects an ability of society to participate in environmental sustainability development. In this article differences of WTP of individual investors were analized on the socio-economic backgrounds. It is clear that the performance of economy expressed by WTP of individuals is a key factor predicting success of sustainable development in the market economy. It is recognized, that individual demand for high quality environment is not necesserily associated with energy efficient investment. The difference in WTP of investors in less or more developed countries seem to be easily explained with the rule of Maslow's hierarchy of needs – the more basic needs are first to be fulfilled.
This correlation is at some degree presented in Environmental Sustainability Index.ESI is a measure of overall progress towards environmental sustainability developed for 122 countries. The three highest ranked countries in 2001 ESI were Finland, Norway and Canada. The three lowest are Haiti, Saudi Arabia and Burundi. Examples of countries in a middle of scoring include Ghana and Honduras. A high ESI rank indicates that a country has achieved a higher level of environmental sustainability, a low ESI rank signals that a country is facing substantial problems in achieving environmental sustainability along multiple dimensions.

Table 2. Components of Environmental Sustainability

Component	Logic
Environmental Systems	A country is environmentally sustainable to the extent that its vital environmental systems are maintained at healthy levels, and to the extent to which levels are improving rather than deteriorating.
Reducing Environmental Stresses	A country is environmentally sustainable if the levels of anthropogenic stress are low enough to engender no demonstrable harm to its environmental systems.
Reducing Human Vulnerability	A country is environmentally sustainable to the extent that people and social systems are not vulnerable (in the way of basic needs such as health and nutrition) to environmental disturbances; becoming less vulnerable is a sign that a society is on a track to greater sustainability.

Social and Institutional Capacity	A country is environmentally sustainable to the extent that it has in place institutions and underlying social patterns of skills, attitudes and networks that foster effective responses to environmental challenges.
Global stewardship	A country is co-operating in collective efforts to conserve international environmental resources such as the atmosphere. We define environmental sustainability as the ability to produce high levels of performance on each of these dimensions in a lasting manner.

Unfortunately ESI index tell us nothing about reasons and effects of actions taken to promote sustainablity. From ESI index we know the more fiancial resoures are the bigger WTP for environment quality, but in comparable GDP per capita groups of coutries ESI idexes varies. We shall now take a closer look at at strategies undertaken to develop sustainability with use of financial incetives. Statistical data proved there is no straightforward correlation beetween the need for high quality environment and investment decisions.
Construction sector in Poland encouters problems borne from economy transition from central menagement to free market. Because of deficiency of flats, the demand for housing is coloured by the strong need for more area for people to live on. The initial cost of investment is then vital, because it is the total amount of usable area what is demanded. NPV value of flat is calculated primarily by it's usable area and location, not by cost efficiency of energy consumption. It doesn't mean, that people don't need a high quality environment, but it is a false assumption hat they would be interested in investmennt in environmental performance of technical systems. There is a lesson gained from financial incentives introduced in Poland, that it is impossible to generate sustainable development by enforcing investors' WTP for energy saving solutions. Economists would probably argue that this is because such incentives were not aligned with market forces. Authors of this article share that economists' point of view. It proved that market forces are not capable to resolve global energy deficiency in forseen future [1]. Polish experience proved there is no sense in supporting market economy by enforcing its strenghts like WTP of individuals. There is a conflict between individual demand for a room to live in and the social demand for a better environment. In emerging market economies that conflict is more intense than in dveloped countries. Poland reveales the rule. Governing bodies belive that energy efficiency problem can be resolved by improving the existing market practices, but it is not true neither for developed countries nor for countries in transition towards free market. What is needed is awarness of the fact that neither political institutions nor market actors are in force to take responsibility for sustainable development. This is because the final user of a building makes no influence on offered standard of a flat in the market charcterized by deficiency of flats. Investors' would respond for financial incentives if they were aware of and share the social need for sustainability. It seems that it 'd better to invest education, than in the market.

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