Proceedings of the Second IASTED Africa Conference
Power and Energy Systems (AfricaPES 2008)
September 8-10, 2008 Gaborone, Botswana

ENERGY CONSERVATION IN HOUSEHOLD

Prof.,Dr.hab.sc.ing. Peteris Shipkovs[1], Dr.sc.ing. Galina Kaskarova[1], Dr.sc.ing. Ilze Purina[1],M.sc.ing. Kristina Lebedeva[1], Dr.sc.ing. Maija Rubina[2], Ing. Juris Golunovs[2], MBA Indra Niedrite[2], M.sc. Martinsh Jirgens[3]
[1]Energy Resources Laboratory, Institute of Physical Energetics, [2]Riga Energy Agency, [3]Ministry of Environment
[1]21 Aizkraukles Street, Riga LV-1006, [2] 49/53 Brivibas Street, Riga, LV-1010, [3] 25 Peldu Street, Riga, LV-1494
Latvia
shipkovs@edi.lv

ABSTRACT
The household in Latvia is the most energy capacious sector – 36.4 % of the total energy consumption has been consumed by household in 2007. According to that the energy demands in household as well as energy conservation potential are very important parts of the management and development of energy sector.

The statistical data of the housing stock and energy consumption in household, energy conversation potentials for household in Latvia are presented in this report.

The methods used for the energy conversation potential for individual and mini-family buildings estimating are discussed in paper. In the paper some ideas, possibilities and solutions of residential block are presented, with the aim that the building would became a user - and environmental friendlier nucleus of a large built structure – the city.

Riga Energy Agency (established with the support of European Union (50% co-financing) in 2007) is independent non-profit entity formed by the municipality. The main objectives for the establishment of Riga Energy Agency (REA): management and coordination of energy supply and energy efficiency in Riga municipality; ensuring of energy efficiency information awareness among local population.

KEY WORDS
Energy conservation, energy efficiency, heat consumption, housing stock.

1. Introduction

Energy demand and also efficiency in housing sector generally depends on various circumstances: social sphere and state or municipal regulations, infrastructure of living area and energy supply, building envelope conditions, population's consumption habits, thinking manner (ownership) and, of course, climate conditions.

The total energy consumption (with climatic correction) in the residential sector of Latvia is more or less stable (total growth in 5 years is 1.9 %) and varies around 60 PJ (Figure 1).

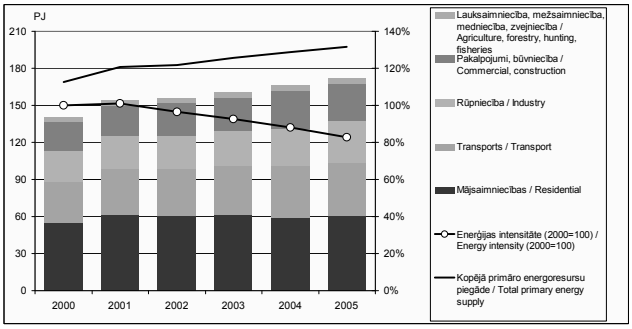

Figure 1. Final energy use: Residential sector – largest share in final consumption (~ 35%)
(Source: Presentation Some Aspects of Transposition of Directive 200632EC in Latvia. 2007. Latvian investment development agency)

The energy demand for space heating has a tendency to decrease – annually for a few per cent and the electricity demand has a tendency to grow annually from 4 to 8 percent.

Table 1
Specific energy consumption in households of Latvia

Type of energy consumption	Units	2001	2002	2003	2004	2005
Final energy consumption with climatic correction*	kWh/ m²	323	318	307	297	301
Consumption for space heating per m² with climatic correction *	kWh/ m²	236	232	220	212	214

* Amount of the long term average degree days - 4243

2. Energy consumption in household sector

The share of space heating in the households final energy consumption varied from 73% in 2001 to 71 % in 2005 and is the largest energy saving potential in housing sector. About 27% to 29% of households final energy consumption has been consumed for hot tap water (HTW)

production, cooking and household electricity needs (Table 1).

Annual amount of heating degree-days is approximately stable in the last few years (see Figure 2), but heating seasons (180 to 210 days per year depending Latvian climate conditions) become a little bit warmer and longer.

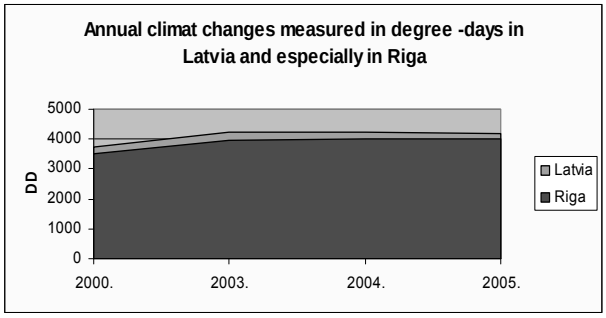

Figure 2. Climate characteristics

Ratio of different energy resources in total household consumption is shown in the Figure 3.

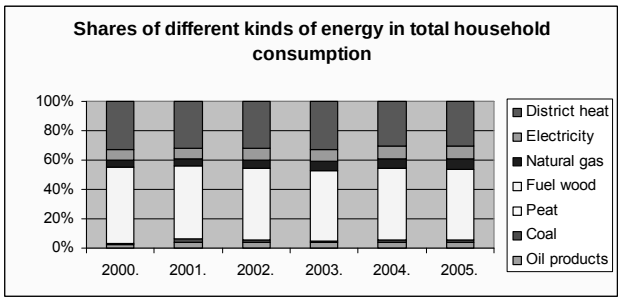

Figure 3. Ratio of different energy sources in total consumption of household

To consider definition terminology - single and double apartment houses will be father called single-family houses and the houses with three and more apartments will be called multi-apartment houses.

Gas consumption slightly grew in the last years due to the new building construction (prevalent single family houses with natural gas boilers) rapid development.

The second largest part of housing energy resources is district heating (DH). It covers most of multi-apartment houses of Latvia. DH has been provided both from CHP plants and boiler houses (BH). The biggest two natural gas-fired CHP plants are into the operation in the country capital Riga. DH share in the CHP mode of the biggest Riga DH company "Rigas Siltums" has been varied yearly around 80%. Mostly in the other big cities heat production for DH has been provided in the gas-fired BH, but wood chips fuel fired BH have been used in the rural area and also in few towns where installed heat capacity of BH does not exceed 16 MW. Energy saving potential of district heat production for households in most of the other Latvian cities relates to CHP mode expansion. Introduction of cost effective ORC (Organic Rankin Cycle) CHP technology in the wood fired rural heating systems will improve also energy efficiency of the energy production for residential sector in future.

Wood fuel-fired individual boilers are widespread in the rural area of Latvian single-family households. Pellets fired individual boilers with flue gas lambda factor control have been offered in the boiler market and it allows significantly improve heat production efficiency in households where old type boiler's efficiency is too low. Condensing gas-fired individual boilers with efficiency exceeding 100% compete in the market with ordinary boilers (efficiency around 92%). In the last few years heat pump installations for space heating and hot water preparation in the new single –family houses have been expanded.

Nearly all of the DH consumers - multi-apartment houses starting from 1995 have been equipped step by step with heat meters and around 95% of DH consumers - with flow-controlled consumer heat substations with automatic climate control for space heating and hot water preparation in the building substation. Big potential for energy saving in households is still possible by improvements of heating system of houses, because widespread building internal one-pipe space heating distribution systems cause heat loss from overheating of part of dwellings due to unbalanced heat distribution. Energy saving is possible to get by replacement of one – pipe system with two pipe building internal heating system as well as installation of thermostatic radiator valves and allocators. Use of allocators is not the technically best solution for distribution of heating expenses between dwellers comparing with the flat level heat meters but of course is more cost effective way to motivate building residents to optimize dwelling indoor climate in energy saving mode.

3. Housing stock in Latvia

Annual growth ratio of the housing stock of Latvia alternated from 0,1% (2001) to 2,6% (2002) and reached 5,5% in the five years (2005/2000).Total area of the housing stock of Latvia in the 2005 was 56,4 million m² compare to the 53,5 million m² in 2001 when this area covered 975785 dwellings and 22,6 m² per resident of the country (ref. to the state statistical data).

Riga covers 30 % (16,7 million m² of total floor space) of all the country housing stock. Also the share of Riga multi-family buildings amount of Latvia is around 30 %. Available data about Riga from Central Statistical Bureau of Latvian is given in the Table 2.

The number of state and municipal housing stock evaluation projects has been performed in the last decade in order to determine capacity and potential of energy efficiency improvements in residential sector. The new more strong legislation requirements have been performed by updated Latvian building codes "Thermotechnics of buildings envelopes" and "Buildings heating and ventilation systems" where some construction terms have been harmonized with the relevant requirements of EU

directive of building energy performance. State "Guidelines for Energy Sector Development 2007–2016" (approved on 06.2006) set a number of implementation benchmarks in field of energy efficiency to be reached.

Table 2
Residential buildings and dwellings at the end of 2004 (Riga)

	Number (pcs)	Share (%)	State	Municipal	Other
Residential buildings	**27713**	**100**	**1052**	**5726**	**20935**
Of which by number of dwellings					
1	13476	48,6	70	327	13079
2	2288	8,3	87	408	1793
3 and more	11831	42,7	862	4957	6012
Without division into dwellings	118	0,4	33	34	51
Number of dwellings	**307925**	**X**	**2691**	**19694**	**285540**

4. Energy saving in household sector

The main target for housing sector is reduction of the specific thermal energy consumption in buildings from 220-250 kWh/m^2/per year to 150 kWh/m^2/per year until 2020.

National Energy Efficiency Action Plan is under preparation. Indicative target for year 2016 – 9%= 12.5 PJ (3483GWh) (calculated according requirements of Directive 2006/32/EC). Residential sector is the main sector for energy efficiency improvement.

The prospective indicative target for the residential sector – in 2016 is 2072 GWh (77,6% of all of the savings).

The main energy saving target group are brick-work and prefabricated slab construction multi-apartment buildings due to the most cost effective refurbishment possibility: up to 50% of energy saving at the acceptable investment payback time. The pilot project in Riga was refurbishment of the building in Ozolciema street 46/3 in 2001 when building envelope element U-values have been reduced significantly by external insulation measures, and internal heating system have been rebuild from 1-pipe to 2-pipe shape with room radiator thermostats. Energy consumption level for space heating in the mentioned building in the last five years is still stable – around 86 kWh/m². Total (with the heat consumption for hot water production) building's energy consumption is around 120kWh/m² to 130kWh/m² annually in this renovated house.

Heat energy saving arrangements is the main for the refurbishment of prefabricated housing because thermal insulation is paramount to both heat energy savings and to repairing facade damage. The advantages of heat energy saving measures, particularly with respect to prefabricated housing, are undeniably evident:

- Reducing heat energy consumption by 40 to 50% is easily attained. These reductions are equal in an average reduction of the total energy consumption to 60 kWh - 80 kWh per squire meter of heated floor area per year.
- A thermally insulated facade results in dry, warm exterior walls and stops weathering damage to the facade.

5. Building renovation

The possible Municipality finance assistance in buildings insulation projects (>1000 m²) for inhabitants was defined with the purpose to promote renovation of apartment houses in Latvia:

1. Energy audit of apartment houses (subsidy) – 50% of energy audit payments, but no more than 285 EUR for one building.
2. Apartment houses renovation with building insulation (subsidy) - 10% from supported payments of renovation project, but no more than 7 EUR/m^2 of building living area.
   Renovation costs with insulation are from 7 to 115 EUR/m².
   Supported payments - replacement or packing of windows of public access areas, insulation of the house external walls and building envelops ceilings (roofs, cellars), renovation and thermo-insulation of the hot water and heating distribution systems risers, replacement of heaters in public access areas, renovation or replacement of the house external doors.
3. Partly covering of payments for building renovation for low-income persons (subsidy) - from the municipality social funds with those funds according increasing.
4. Rotation fund formation for renovation of apartment buildings in Riga municipality
   Rotation fund will be formed progressively with initially payment of 1,400 EUR and annual supplement of fund with analogue sums in each 5-10 years. It will give possibilities with fund of this municipality to support 10 and more houses insulation.
   From the rotation fund gotten finance (interest-free loan or soft credit) inhabitants will begin to pay back progressively after finishing of renovation, mainly from the saved money (heat consumption costs) or slightly more for credit repayment, which can be not longer as 10 years.

6. Conclusion

In view of these advantages, the main questions are - which energy-saving measures are optimal from a cost-benefit point of view and how to provide financing for them. The key term for successful process of housing refurbishment are awareness campaigns for inhabitants in energy saving methods, advantages and readiness to cooperate, make common decision to start implementation of cost effective energy saving measures. The necessity to have municipal institution with the capacity to deal both with energy management in municipal scale and direct work with population grew rapidly. Therefore in 2007 Riga Energy agency was established within EU Intelligent Energy -Europe program (50 % co-financing).

In its work Riga Energy Agency follows to the accepted Riga city "The Concept of the Heat Supply Development for the Years 2006 – 2016".

Now available data of more than 3500 multi-family buildings –DH consumers - owned by municipality have been collected and energy consumption mapping included monthly heat consumption for 5 years period has been already arranged in the data base for further evaluation and analyses by Agency. Municipal energy efficiency action plan of the Riga city will be developed based on the "The Concept of the Heat Supply Development for the Years 2006 – 2016". Key activities of the proposal for the municipal energy efficiency action plan:

- Promotion of energy efficiency in single- and multi-family houses;
- Promotion of energy efficiency in public buildings;
- Establishing and/or adaptation of unified energy audit system;
- Legislative alignment in energy efficiency field (Law on energy performance of buildings – implementation of Directive 2002/91/EC on the energy performance of buildings – submitted for approval to Saeima (parliament) and Law on energy efficiency – under discussion;
- Incentives for establishment of the municipal revolving fund for financial support of energy efficiency measures in the municipal housing sector;
- Information of final consumers.

Energy efficiency action plan of Latvia as well as energy efficiency action plans for different cities especially for Riga will be the core documents that highlight the energy efficiency increase possibilities and more detailed ways how to reach them.

References

[1] P.Shipkovs, G.Kashkarova, K.Lebedeva. Thermal insulation in buildings in Latvia. NAS EnerBuild RTD. *Book of proceedings. Research Directorate general.* EC. Brussels 2003, 169-174 pp.

[2] Janis Rekis, Some Aspects of Transposition of Directive 2006/32/EC in Latvia. *Latvian Investment and Development Agency presentation,* September, 2007.

[3] BEEN Results Manual in English. *Project document. "Better Energy Efficiency Network" (BEEN).* Berlin. December, 2007.

[4] *Housing Stock in Latvia*. 2005. Central Statistical Bureau of Latvia, 2006.

[5] *Latvian energy in figures.* Latvian Investment and Development Agency. 2006.

[6] *Riga in figures 2005.* Central Statistical Bureau of Latvia, 2006.

[7] "Riga Energy Agency. Structure, objectives, activities, accomplishment in 2007". *Presentation on the web page http://www.rea.riga.lv.*