



Ministry of Nature Protection of RA
Ministry of Urban Development of RA



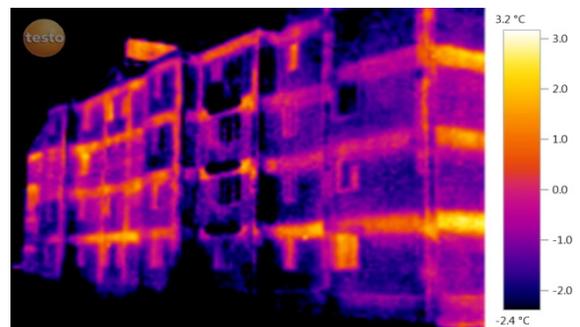
Empowered lives.
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Improving Energy Efficiency in Buildings UNDP-GEF/00059937 project

**Energy Audit and Monitoring Implemented
in building #2 of «Mush-2» residential area in Gyumri city**

To perform activities for improvement of energy efficiency in buildings, a demonstration building (of “4a” type) was selected in Akhuryan community of Shirak marz of Armenia. On June 30, 2011, a three-lateral Letter of Intent was signed between Ministry of Urban Development, “Glendale Hills” CJSC (the developer company) and UNDP.

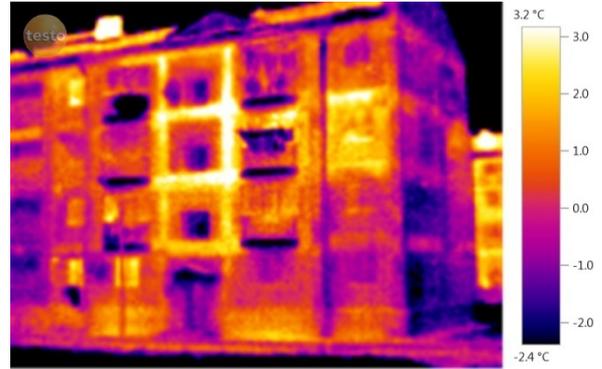
For a comparative study, building #2 in “Mush-2” residential area of Gyumri city was selected: located in the same climatic zone, built with a similar construction technology, highly populated and showing the largest consumption of natural gas and electricity. This angle-shaped structure (of “4a” type) with total area is 2470 m² has three entrances, four storeys and 36 apartments. The building’s operation commenced in year 2010.



Picture 1. Gyumri city, “Mush-2” residential area, bld.#2, northern side, 09.12.2011.

The photo was shoot using Testo 875-2 device.

Monthly data on actual consumption of natural gas and electricity in the building was collected for one year (from November 2010 to October 2011 inclusive). Heat losses from the building’s envelope were estimated based on norm-defined comfort level. The results were compared with the actual consumption of natural gas and electricity. As revealed, the actual comfort level in the building was much lower than the norm-defined one due to low life quality of the residents and high number of unpopulated apartments in the building. Extensive heating season in Gyumri city, 188 days, makes that fact especially important.



Picture 2. Gyumri city, “Mush-2” residential area, bld.#2, southern side, 09.12.2011.

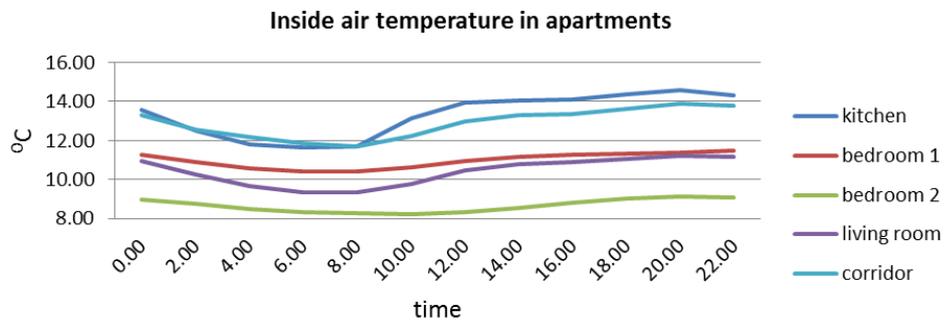
The photo was shoot using Testo 875-2 device.

To receive actual pattern of the heat losses from the building’s envelope, shooting of the envelope with infrared camera was performed. To perform qualitative assessment of the building’s surface temperature per the photos presented, the color scale in the right-hand side of the picture shall be used.



Picture.3. External look of the devices that record temperature and relative humidity of air (HOBO)

With assistance of “Third Nature” NGO, the Project’s experts visited the building’s apartments. To verify the validity of the previously performed estimations (for the period from November 20, 2011 to January 26, 2012), 51 data loggers were installed in and out of the buildings’ apartments to record temperature and air relative humidity. Based on the loggers’ readings, sample-based records were compiled on average indoor air temperature was estimated for certain areas, rooms, premises, apartments and the building as well as the dew point temperature and indoor air relative humidity.



Picture.4. Graphical representation of averaged data on inside air temperatures in the heated apartments where thermometers were placed



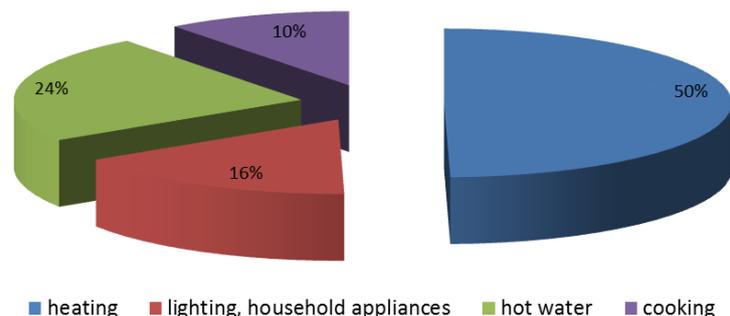
Energy passport

Values of energy efficiency and thermal technical indicators are stated in four rows in energy passport of the building:

Required values	Values as of RA Construction Norms II-7.02-95 “Construction thermophysics of building envelopes; design norms” under a 100% comfort level (20°C temperature is maintained inside the building; the entire building is heated throughout the heating season of 188 days in Gyumri)
Design values	Values set by the building design for 100% comfort level (20°C temperature is maintained inside the building; the entire building is heated throughout the heating season of 188 days in Gyumri)
Actual normalized values	Values calculated/measured from as built building and a 100% comfort level (20°C temperature is maintained inside the building; the entire building is heated throughout the heating season of 188 days in Gyumri)
Actual values	Values calculated/measured from as built building and a actual comfort level

Summary and Conclusions

- The values of adjusted heat transfer resistance (R-value) of all external constructions of the building envelope do not meet the required norms.
- Heat losses from the building envelope (by construction types) are not distributed equally; there are numerous thermal bridges.
- Occupancy rate of the building (apartments operating during the heating season) is 65%, with 44% being entirely heated and 21% partially. 35% of the apartments in the building currently are not occupied and not heated, thereby lowering the comfort level in the entire building.
- Common-use areas are not heated either; however, due to doors and windows in the halls the temperature is around +1°C.
- Annually, primary energy consumption in the building is as follows: heating (50%), hot water supply (24%), lighting, household appliances and office equipment (16%), and cooking (10%).



Picture.5. Consumption of fuel/energy in the building, broken down by the type of end uses

- Heating is provided through individual boilers using natural gas (78%), various types of electric heating devices (16%) and gas stoves (6%).
- An actual comfort level of heating in the building (including common-use areas) is 43% of the required standard value.
- The amount of energy used for heating under the existing, lower-than-required level of comfort in the building and given the actual (R-value) would suffice to ensure a 100% comfort level in case the required values of heat transfer resistance are secured.
- The potential for primary energy saving in heating the building (the difference between the actual normalized values and the required values) will amount to 234,080 kWh/year (for 92% of thermal efficiency for boilers and for 8,000 kcal/nm³ calorific value of natural gas) or to 25,200 nm³ of natural gas per year or 28.7 tons of equivalent fuel per year.
- The potential for CO₂ emissions reduction will be 48 tons annually.
- Energy performance class of the building is D (as to IGCN 24-01-2011 “Thermal protection of buildings”), i.e. it is desirable that the building should be reconstructed since designing a building of that category is impermissible [According to the Armenian standard based on the European standard EN 15217:2007, it corresponds to energy performance class G, which is used to designate building with the lowest energy performance].

Energy efficiency label

The energy efficiency class of the building was set according to MSN 24-01-2011 “Thermal Protection of Buildings” and EN 15217:2007 “Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings” building codes

Energy Efficiency Label	Building Energy Performance	Actual normalized version	Design version	Required version
	Revised MSN 2 04-03-2004 “Thermal Protection of Buildings”			
	More energy efficient			
	A+			
	A			
	B+			
	B			
	C+			
	C			
	C-			
	D			
	D-			
	E			
	Less energy efficient			
		173 kWh/m ² year	157 kWh/m ² year	74 kWh/m ² year
	<small>Thermal energy annual savings potential: 215 354 kWh/year Thermal energy annual specific savings potential: 99 kWh/m² year Primary fuel type used: natural gas Primary fuel annual savings: 24 472 nm³/year Primary fuel annual specific savings potential: 11 nm³/m² year</small>			
Administrative information Address: Mush-2 district, #2, Shirak marz, Republic of Armenia Total Area: 2388 m ² Date of certificate: 05.04.2012 UNDP-GEF/00059937 Project expert Artur Tsughunyan				

Energy label according to the MSN 24-01-2011
intergovernmental building code

Energy Efficiency Label	Building Energy Performance	Actual normalized version	Design version	Required version
	EN 15217:2007 “Energy performance of buildings. Methods for expressing energy performance and for energy certification of buildings”			
	More energy efficient			
	A			
	B			
	C			
	D			
	E			
	F			
	F-			
	G			
	Less energy efficient			
		173 kWh/m ² year	157 kWh/m ² year	74 kWh/m ² year
	<small>Thermal energy annual savings potential: 215 354 kWh/year Thermal energy annual specific savings potential: 99 kWh/m² year Primary fuel type used: natural gas Primary fuel annual savings: 24 472 nm³/year Primary fuel annual specific savings potential: 11 nm³/m² year</small>			
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Energy label according to the HST EN 15217:2007
building code

