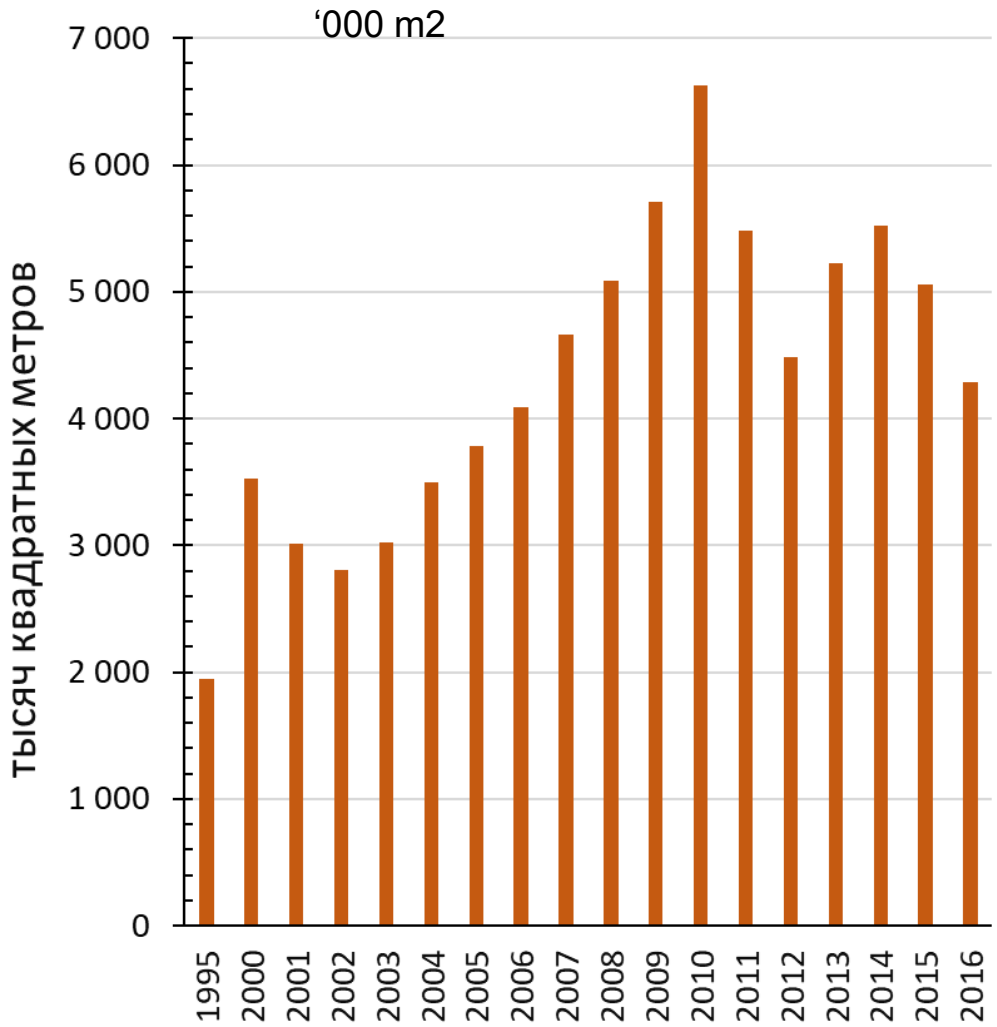
1 November 2017

Improving Energy Efficiency of Residential Buildings

Minenkov A.V.
Head
Department for Scientific and Technical Policy and Foreign Economic Relations
Department for Energy Efficiency
State Committee for Standardization of the Republic of Belarus

Housing Sector

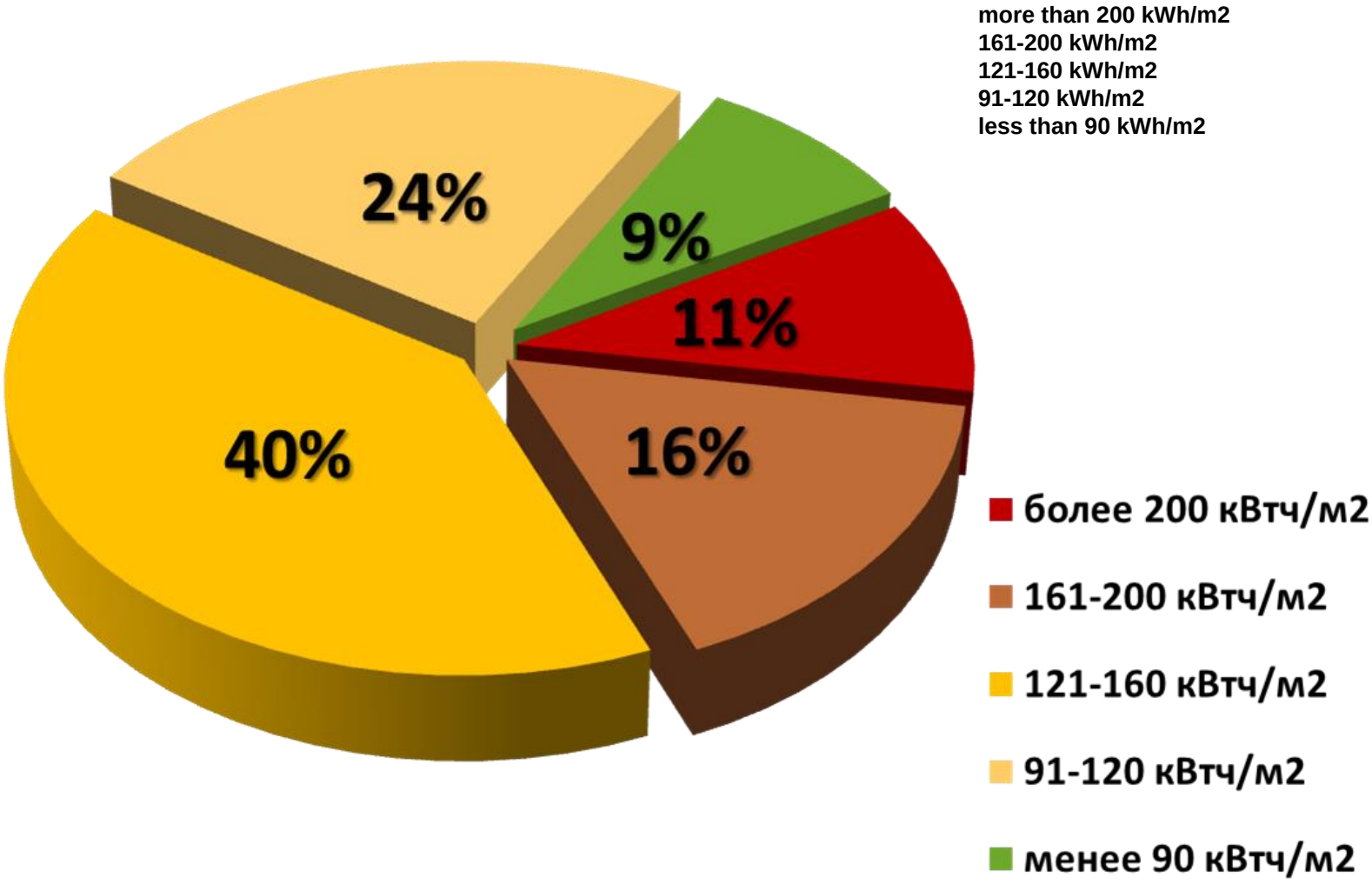
- In total, **1.565 mln** residential buildings
- Total floor space – **248.7 mln m²**
- Multi-storey buildings – **57%**
- Construction volume:



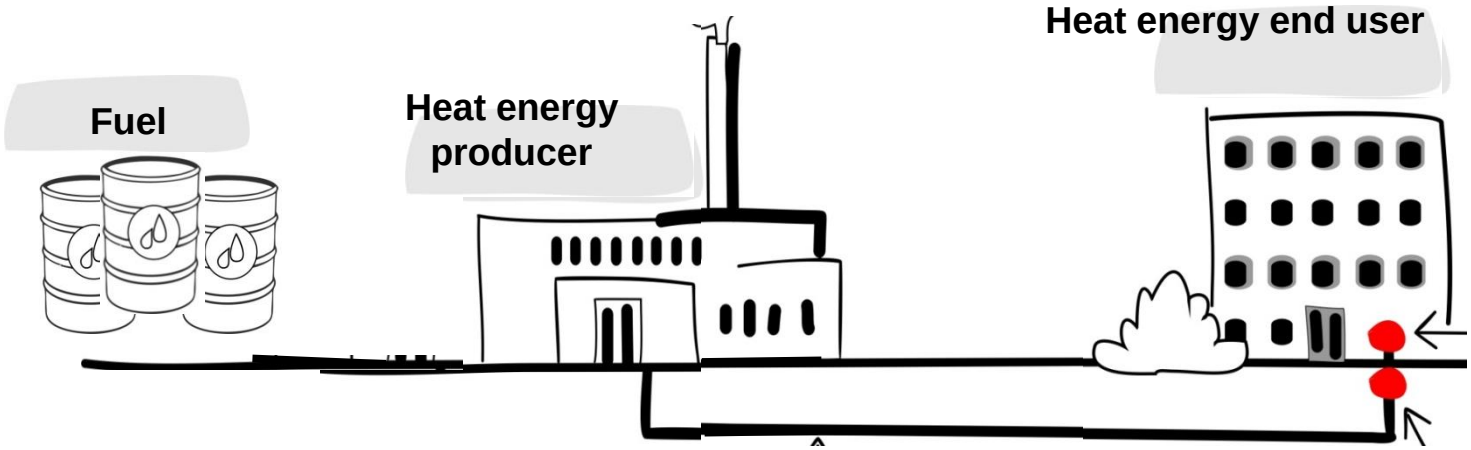
- Residential buildings – the largest thermal energy consumers:

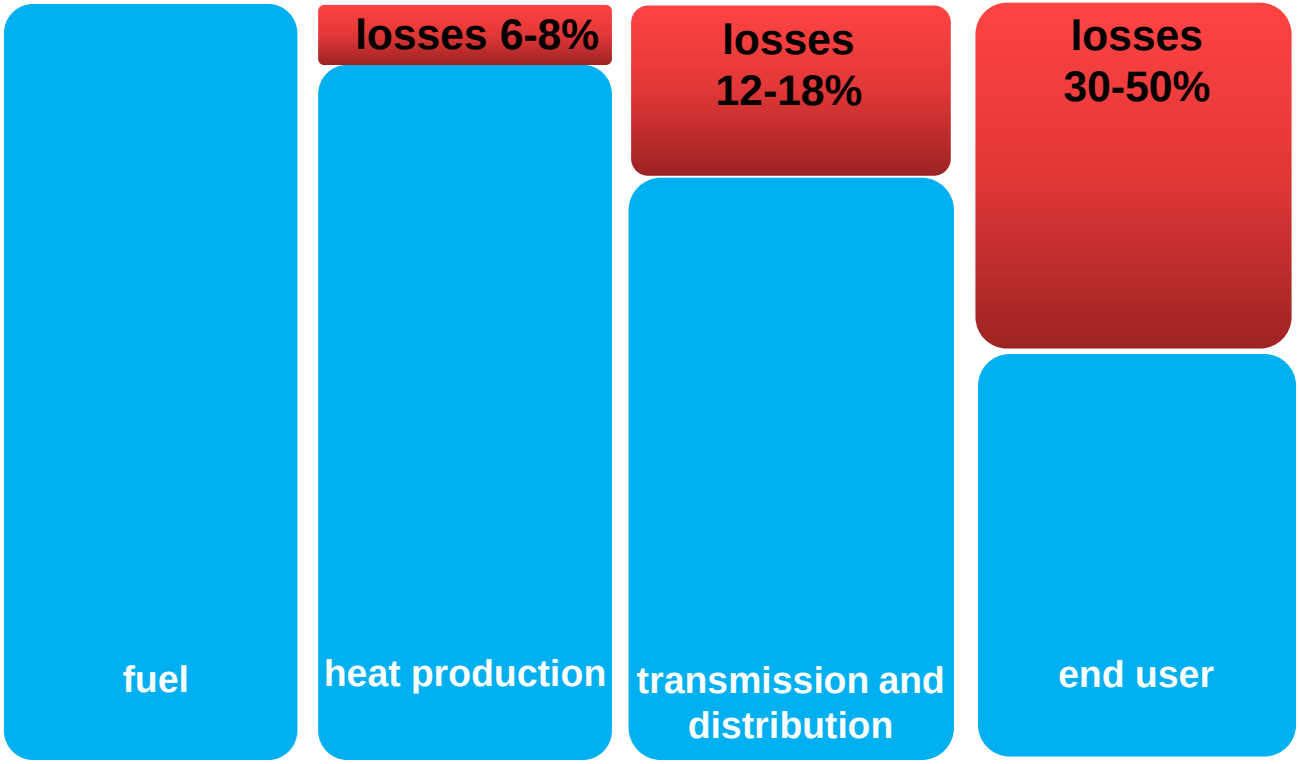
Heat Consumption for Space Heating and Domestic Hot Water Supply

Distribution of living floor spaces by level of heat energy consumption:



Losses in the Building Heat Supply System





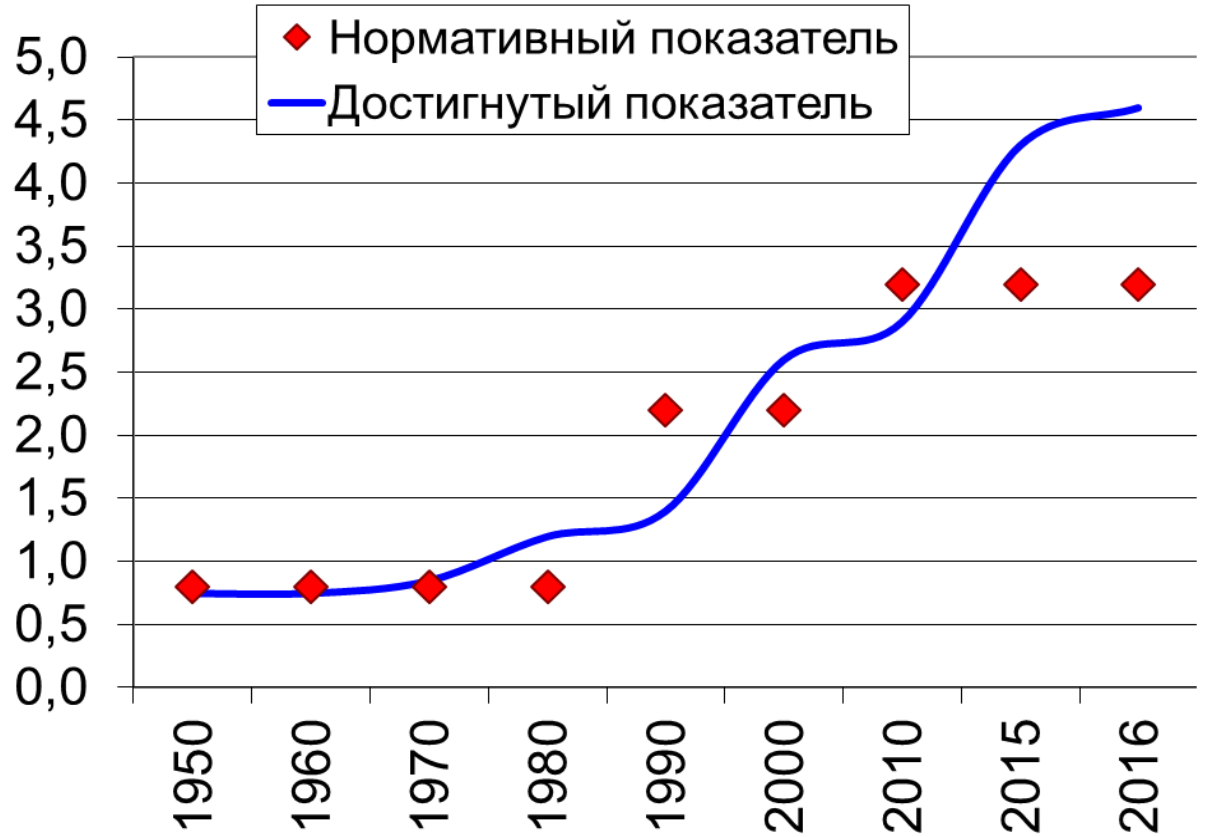
Energy-loss distribution (%):

- Natural ventilation
- Attic floor
- Basement floor
- Windows
- Outer walls

Enhancing Requirements for Energy Efficiency of Enclosing Structures of Residential Buildings

Thermal resistance (m^2 $^oC/W$):

-Standard indicator
-Achieved indicator

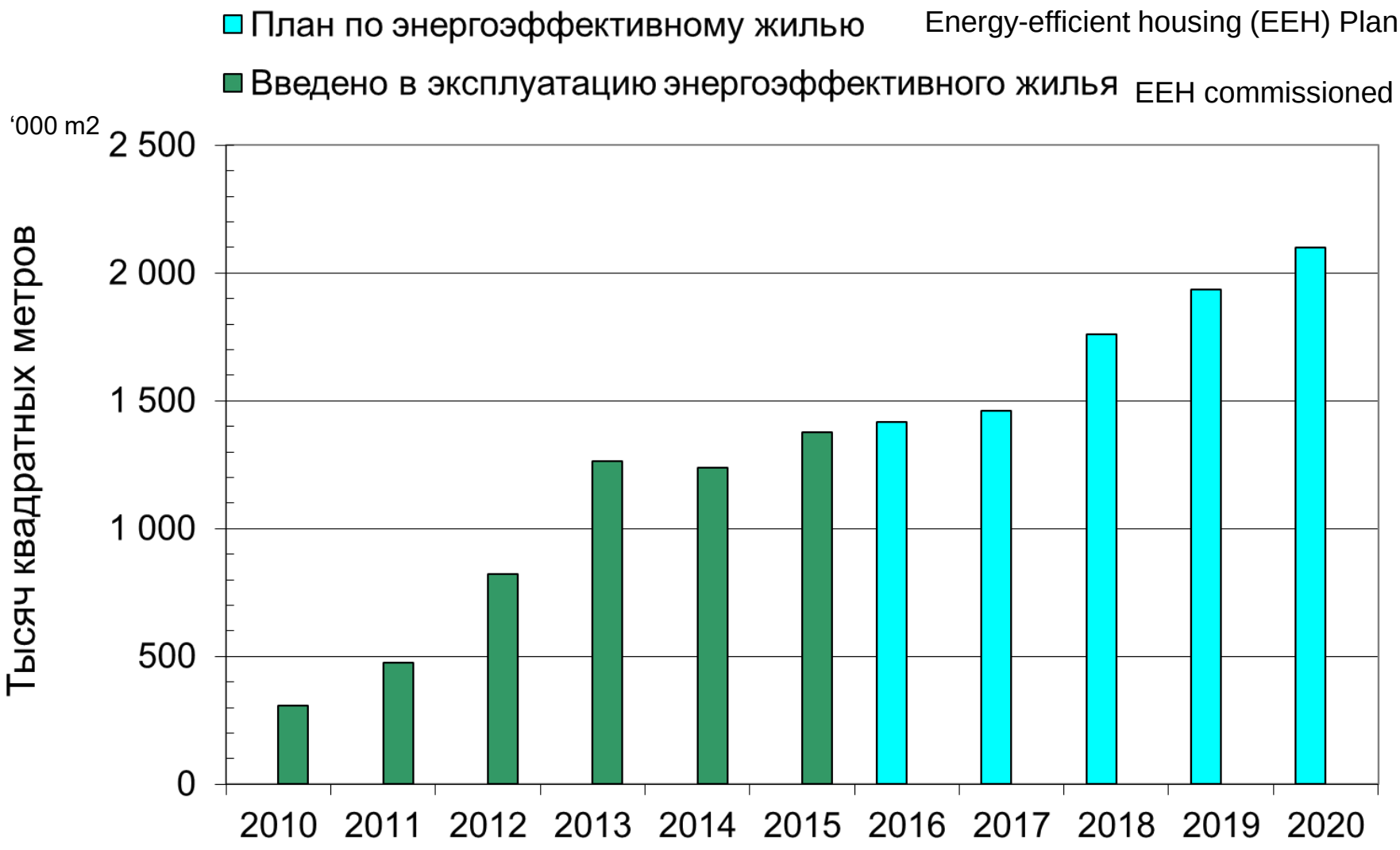


Other Energy-Efficient Solutions

- Solutions minimizing the area of enclosing structures, solar architecture and optimization of enclosing structure heat transfer resistance
- Electric power and heat energy: consumption metering and management
- Reducing air change-related heat energy losses by shifting to the supply and exhaust ventilation with exhaust air heat recovery
- Reducing heat energy losses by recovering grey waste water heat
- Using heat pumps (soil/sewage effluents heat recovery)
- Utilizing renewable energy sources (photovoltaic panels, solar heaters)

Energy-Efficient Housing

State Program “Housing Construction” for 2016-2020 (Resolution of the RB Council of Ministers dated 21.04.2016, No. 325)



Main Barriers Impeding Energy Efficiency Improvement

- Need to develop technical regulatory framework
  - Technical Regulation “Energy Efficiency of Buildings” is under elaboration
  - energy efficiency conformity confirmation system is not in place
- Weak incentives for business (developers, builders, housing and public utilities) and investors (tenants and occupants):
  - cross subsidies and tariff policy;
  - economic indicators (IRR, NPV) are not evident due to small number of examples for analysis and also without accounting other income items
- Lack of experience and knowledge:
  - design organizations lack sufficient experience and knowledge in the field of designing energy-efficient buildings
  - builders lack adequate skills in constructing energy-efficient buildings
  - operating organizations experience shortage of the trained staff
- Undeveloped infrastructure:
  - limited number of domestic manufacturers to produce most of the essential equipment components
  - lack of the regular monitoring of the energy-efficient design of residential buildings and energy audit of buildings
  - absence of a market of services for operating and maintaining such buildings
  - inadequate outreach efforts, inclusive of systematic training of the occupants in the field of proper operation of energy-efficient equipment.

Demonstration Sites of the Department for Energy Efficiency and UNDP/GEF Project "Improving Energy Efficiency in Residential Buildings"

- Demonstrating potential and economics of improving energy efficiency in buildings of standardised blocks of flats
- Coverage of up to 82% of the annual residential building heat energy consumption
- District heating network remains a peak heat supply source

District	Typical apartment building	Total floor space (m^2)	Developer
Mogilev	Standard modular prefabricated semi-frame 10 floors, 4 entrances, 180 apartments	11,075	CUE "Mogilev Capital Construction Department"
Minsk	Standard pre-cast large panel 19 floors, 1 entrance, 133 apartments	7,590	"MAPID" OJSC
Grodno	Standard, with brick load-bearing walls and outer cellular concrete walls 10 floors, 3 entrances, 120 apartments	8,086	"Grodnozhilstroi" OJSC

Residential building in Mogilev

Design specific heat consumption parameters, kWh/(m^2/year):

- 25 for heating and ventilation (in contrast to current 40-50)
- 20 for domestic hot water supply (in contrast to current 80-90)

Residential building in Minsk

design specific heat consumption parameters, kWh/(m^2/year):

- 25 for heating and ventilation (in contrast to current 40-50)
- 40 for domestic hot water supply (in contrast to current 80-90)

Residential building in Grodno

design specific heat consumption parameters, kWh/(m^2/year):

- 15 for heating and ventilation (in contrast to current 40-50)
- 30 for domestic hot water supply (in contrast to current 80-90)

Combined Heating and Ventilation System

Apartment ventilation system with exhaust air heat recovery annually saves:

- 0.06 Gcal of heat energy per m^2
- 70 tons of f.o.e. per each similar house

Over the period of the building's service life, the saving would be 3.5 ths tons of f.o.e.

Air Change and Heat Supply Regulator

Air change and heat supply regulator controls:

- heating depending on exhaust air temperature (integral estimation) set by an occupant
- air change rate set by an occupant

Waste Water Heat Recovery System

- Estimated saving of heat energy for domestic hot water supply is about 20%
- Annual heat energy saving is up to 0.04 Gcal/m2

Use of Thermopiles

Number of bored piles – 32, total length of piles – 305 m

F1155 circulating heat pump, rated heat takeoff capacity – 18 kW

Annual heat energy saving: 0.01 Gcal/m^2

Sewage Effluents Heat Recovery

- Rated heat takeoff capacity: 120 kW
- Two F1345 dual-compressor circulation heat pumps
- Annual heat energy saving: 0.06-0.10 Gcal/m2

Solar PV-Panels

Demand in the electric energy for communal use may be met by more than 20% without using batteries and up to 35% by using batteries or by transmitting to the grid

Solar Heaters for Domestic Hot Water Supply

A solar collector saves energy for the DHWS: by not less than 20% in winter season and by not less than 70% in summer season

Main Results

- Three pilot residential buildings having a total living floor space of about 33,500 m^2 were designed with an annual specific energy consumption lower than 25 kWh/m^2 for the ventilation and air conditioning system and lower than 40 kWh/m^2 for the domestic hot water supply system. To date, none of residential buildings has such a design in Belarus
- Increase in cost by not more than17% on the average
- Reduction in the annual heat energy consumption by about 3.5 MWh per apartment
  - while the annual electric energy consumption by 0.4 MWh per apartment is to increase
- The technologies used will allow the following indicators to be achieved:
  - four-fold reduction in heat energy consumption if new buildings are built according to the Project-proposed model
  - saving up to 5 thousand tons of oil equivalent over the entire service life of the building
- Reduction in greenhouse gas emissions up to 2030:
  - by 21.4 thousand tons of CO2-equivalent – direct effect
  - By **8 million tons of CO2 equivalent** – cumulative indirect effect

1 November 2017

Thank you for being with me!

Minenkov A.V.
Head
Department for Scientific and Technical Policy and Foreign Economic Relations
Department for Energy Efficiency
State Committee for Standardization of the Republic of Belarus