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International Conference
"The prospects for introduction of "green" innovative energy efficiency technologies in the electric power industry of Turkmenistan"

SEIT building, 62 Bayram Khan st, Mary, 19 March 2024

Studying practices of the Republic of Kazakhstan in implementation of innovative energy efficiency technologies in the housing sector

Zhaxylyk Tokayev
International Consultant, SECCA

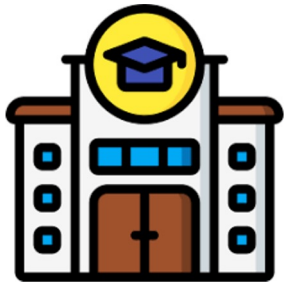
Stantec | intec | ACTED | European University Institute | Robert Schuman Centre for Advanced Studies | FSR ENERGY Florence School of Regulation

On Architectural, Town-planning and Construction Activity in the Republic of Kazakhstan

Building

- an artificial structure consisting of load-bearing and enclosing constructions forming a mandatory aboveground closed space and used, depending on its functional purpose, for living or staying of people, for performing production processes, and placing and storing material values

- **Residential**
- **Public**
- **Commercial**
- **Industrial**



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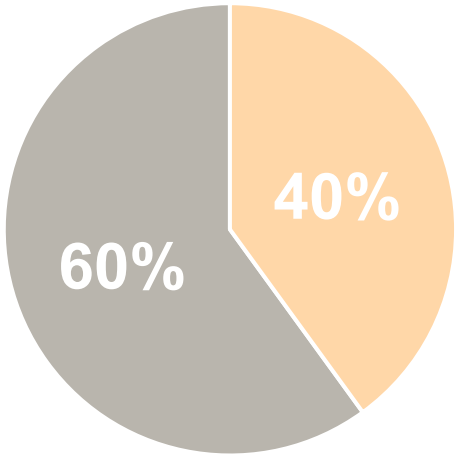
SIGNIFICANCE OF THE ISSUE BASED ON EU EXPERIENCE

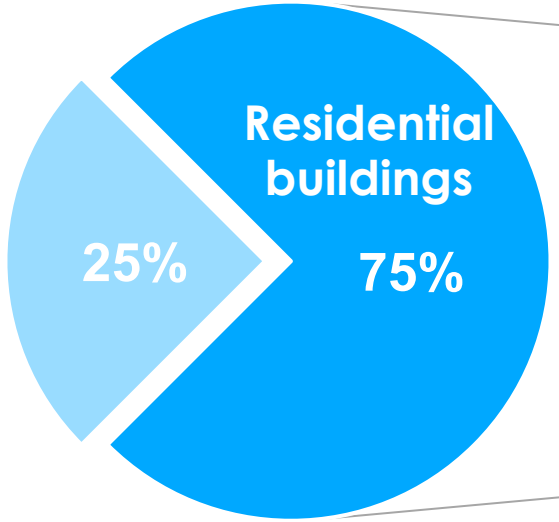
We spend 90% of our time in buildings

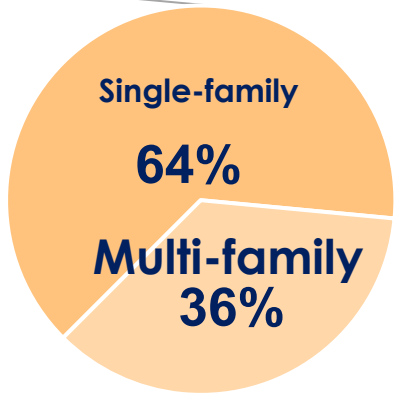
Share of other sectors



Share of buildings in total energy consumption in the EU

Share of non-residential buildings in the total energy consumption of all buildings





Distribution of energy consumption by type of housing

Source: BPIE

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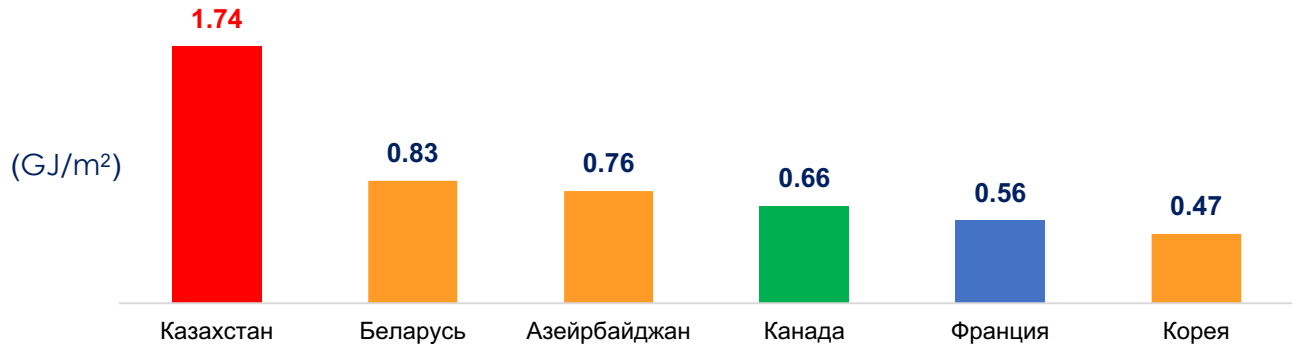
ENERGY EFFICIENCY INDICATORS IN HOUSING

	2014	2015	2016	2017	2018	2019	2020	Change (+ %)
Total energy consumption in housing, thousand toe	9900	10711	9927	10934	11277	15145	13469	36%
Energy consumption in residential sector, GJ	414 498 686	448 460 322	415 627 350	457 783 589	472 138 207	634 092 450	563 925 647	36%
Energy intensity per capita (GJ/person)	**24**	**26**	**23**	**25**	**26**	**34**	**30**	**25%**
Energy intensity per unit area (GJ/m2)	**1.2**	**1.3**	**1.2**	**1.3**	**1.3**	**1.7**	**1.5**	**23%**
Energy intensity per building unit (GJ/building)	**181**	**196**	**183**	**199**	**202**	**268**	**236**	**31%**

Low energy efficiency of buildings



Energy intensity per unit area in housing of the Republic of Kazakhstan is

3 times

higher than the figure for Canada

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HOUSING STOCK OF KAZAKHSTAN

2 493 685
Residential buildings

405,2 million sq. meters housing stock

2 182 144
Single-family residential buildings

311 541
Multi-family residential buildings

Multi-family houses

Total	By number of apartments				
	2	3	4	5	6 and over
311 541	209 766	20 037	13 799	3 207	64 732

Based on external wall materials	Brick, stone	Large panels	Frame and panel	Large blocks	Monolithic concrete	Other materials
311 541 pieces	105 974	8 362	2 841	3 458	22 398	168 508
203,3 million m2	78,4	18,8	1	2,3	41,6	61,1

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HOUSING STOCK OF KAZAKHSTAN

Multi-family residential buildings

56 954

1,3%

FAILING HOUSES

791

4,8%

DILAPIDATED HOUSES

2 763

31,1%

TO BE MAJORLY REPAIRED

17 734

MAJOR RENOVATION OF MULTI-FAMILY HOMES

For 2011-2023, **65.4 billion KZT** was allocated. **3,623 multi-family homes -** renovated in 2011-2022,

including **501 multi-family homes** - from repayable funds (6.6 billion KZT)

It is planned to renovate **234 multi-family homes** in 2024 for a total amount of **13.8 billion KZT**

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MECHANISMS FOR MAJOR RENOVATION OF MULTI-FAMILY HOMES

CURRENTLY

REPAYABLE

BUDGET LOAN

at 0,1 % for 7 years

SINCE 2020 (FOR CERTAIN CASES)

NON-REPAYABLE

FINANCING FROM **THE LOCAL BUDGET** FOR ROUTINE AND MAJOR REPAIRS OF FACADES, ROOFING OF MULTI-FAMILY RESIDENTIAL BUILDINGS, IN ACCORDANCE WITH THE RULES FOR ARCHITECTURAL DESIGN

WITHIN THE PROGRAM FOR MODERNIZATION OF THE HOUSING AND UTILITIES FROM 2011-2020

REPAYABLE

IN INSTALMENTS

INTEREST-FREE FOR 15 YEARS

AT OWNERS' EXPENSE (SAVINGS ACCOUNT)

OWNERS

Compulsory deposit of

0,005 MCI. - 17 KZT

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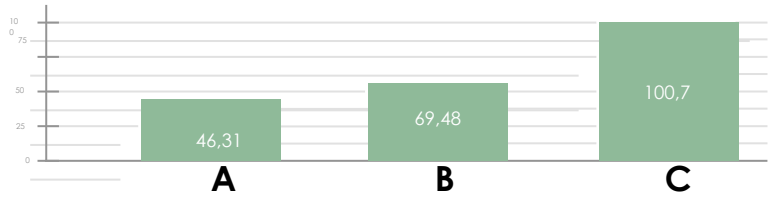
CALCULATION OF ECONOMIC EFFICIENCY

Comparative table of calculations of the economic efficiency of an administrative building for various energy efficiency classes

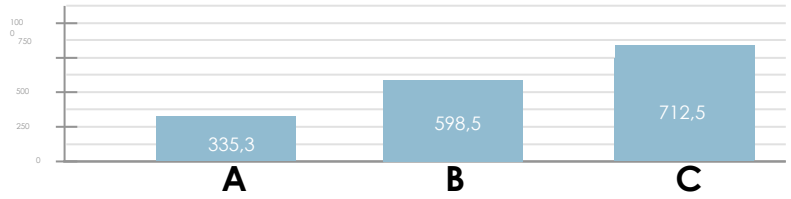
Cost of thermal energy from coal (thousand KZT)



An administrative building with a very high energy efficiency class can save about (110.76 thousand KZT - 46.31 thousand KZT) - 54.39 thousand KZT during the heating period.

Comparative table of calculations of the economic efficiency of a 60-apartment residential building for various energy efficiency classes

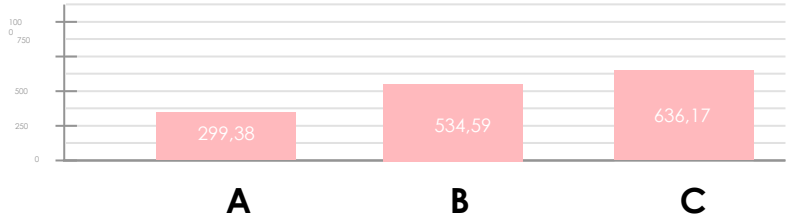
Cost of thermal energy from coal (thousand KZT)



A 60-apartment residential building with a very high EE class can save about (598.5 thousand KZT - 335.3 thousand KZT) - 263.2 thousand KZT during the heating period.

Comparative table of calculations of the economic efficiency of the clinic for various energy efficiency classes

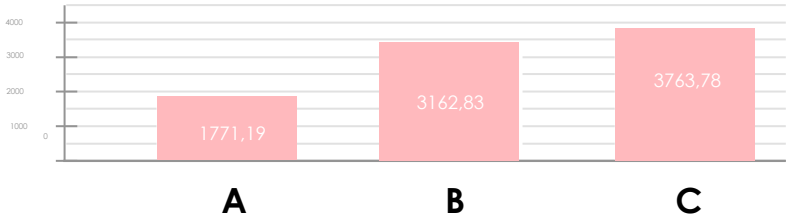
Cost of thermal energy from coal (thousand KZT)



A clinic building with a very high EE class can save about (534.59 thousand KZT- 299.38 thousand KZT) - 235.21 thousand KZT during the heating season.

Comparative table of calculations of the economic efficiency of a secondary school for various energy efficiency classes

Cost of thermal energy from coal (thousand KZT)



A secondary school building with a very high energy efficiency class can save about (3,162.83 thousand KZT - 1,771.19 thousand KZT) - 1,391.64 thousand KZT during the heating period .

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DEMONSTRATION PILOT PROJECT FOR RECONSTRUCTION OF A RESIDENTIAL AREA IN ASTANA

Purpose of this pilot project is: implementation of a demonstration project for the comprehensive reconstruction (modernization) of multi-apartment buildings and adjacent areas

5 BUILDINGS IN ASTANA

Now

After

As a result of the project implementation the following activities will be carried out:

*Energy **modernization** of 5 multi-apartment residential buildings (400 apartments) and one non-residential building;*

***Utility networks** (sewage, water supply, electrical networks) **to be replaced**;*

***Public infrastructure to be improved** (renovation of the playground and recreation area for residents, car parking);*

*Installation of **street LED lighting** of the block;*

Introduction of bicycle parking.

Funded by the European Union

ACTIVITIES UNDER THE PILOT PROJECT

Preparation of master plan and design documentation, examination. Grant

Insulation and roof repair. At the expense of the Regional Development Program

Enclosure and glazing of balconies in the same style - grant

Replacement of entrance (wooden) windows and installation of windows in basement openings. Grant

Restoration of the blind area - Grant

Major repairs of external walls. Grant.

Insulating the basement ceiling. Grant

Installation of entrance and facade "smart" lighting - Grant

Replacement of sewerage pipelines in basements at the expense of residents and apartments' owners cooperative

Installation of automated heating points, balancing, replacement of heating pipes, hot water supply,, cold water supply - Grant

Replacement of entrance doors with insulated ones - Grant

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BUILDING DESCRIPTION AND THERMAL IMAGING

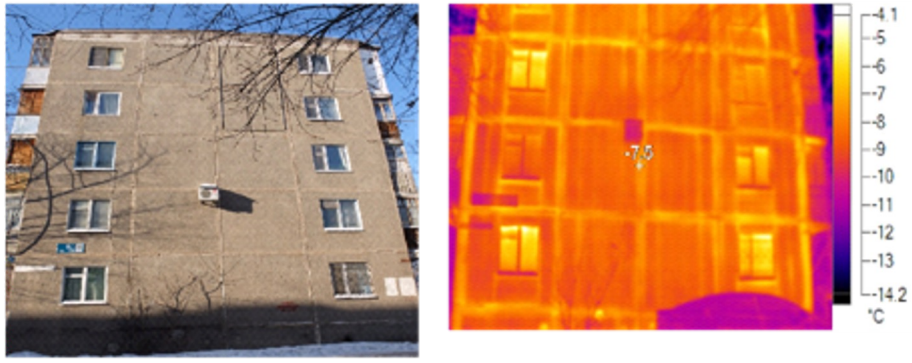
1964
year of construction

4 entrances

80 apartments

4 apartments per section

A five-story large-panel building with a basement, rectangular in plan



(б)

(в)

Funded by the European Union

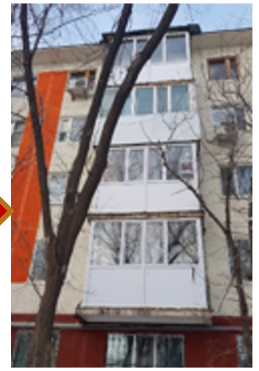
ACTIVITIES UNDER THE PILOT PROJECT

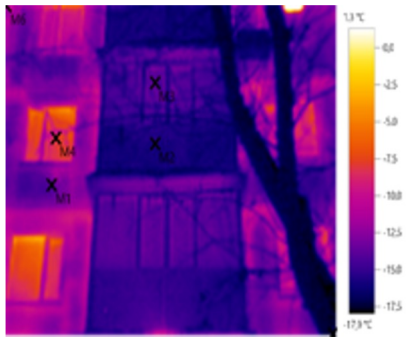
Insulation and sealing

interpanel seams will save 41,258 kWh of thermal energy per year (17 tons of CO2 per year)

Balcony glazing

will save 49,749 kWh of thermal energy per year (20 tons of CO2 per year)





Modernization of engineering systems

and installation of automated heating points will save 137,823.7 kWh of thermal energy per year (63.4 tons of CO2 per year)

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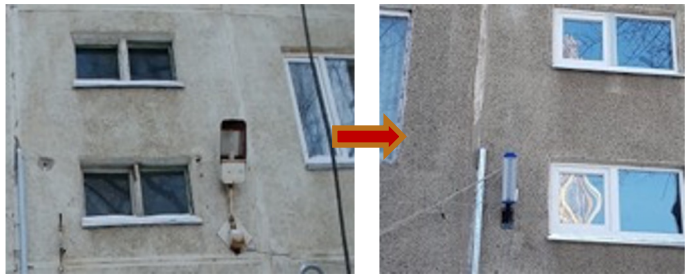
ACTIVITIES UNDER THE PILOT PROJECT

Basement ceiling insulation

will save 241,000 kWh of thermal energy per year (118 tons of CO2 per year)

LED lighting above the entrance

will save 759 kWh of electrical energy per year (0.5 tCO2 per year)



Window replacement

in the entrances will save 9871 kWh of thermal energy per year (8 tons of CO2 per year)

LED lighting in entrances

will save 1095 kWh of electrical energy per year (1.1 t CO2 per year)

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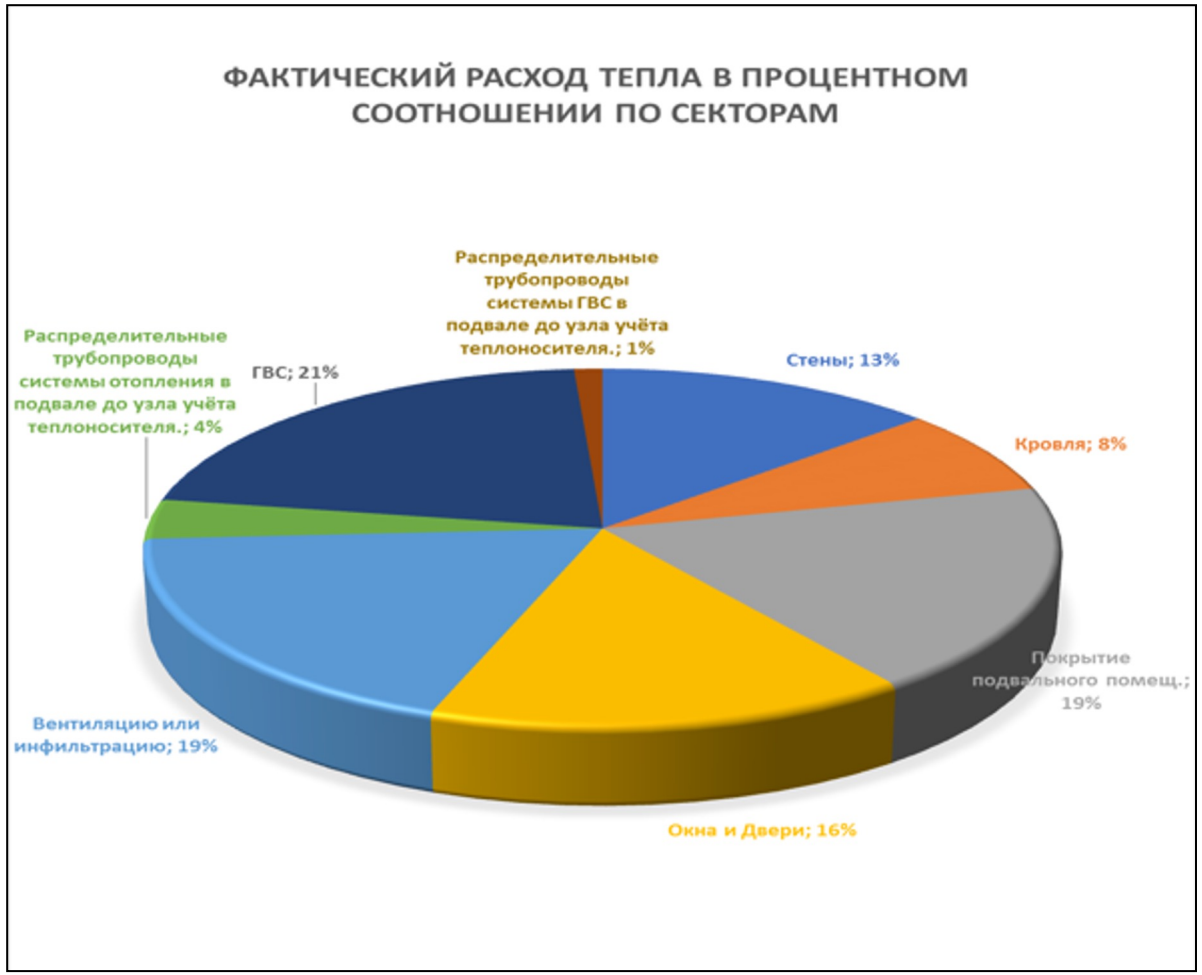
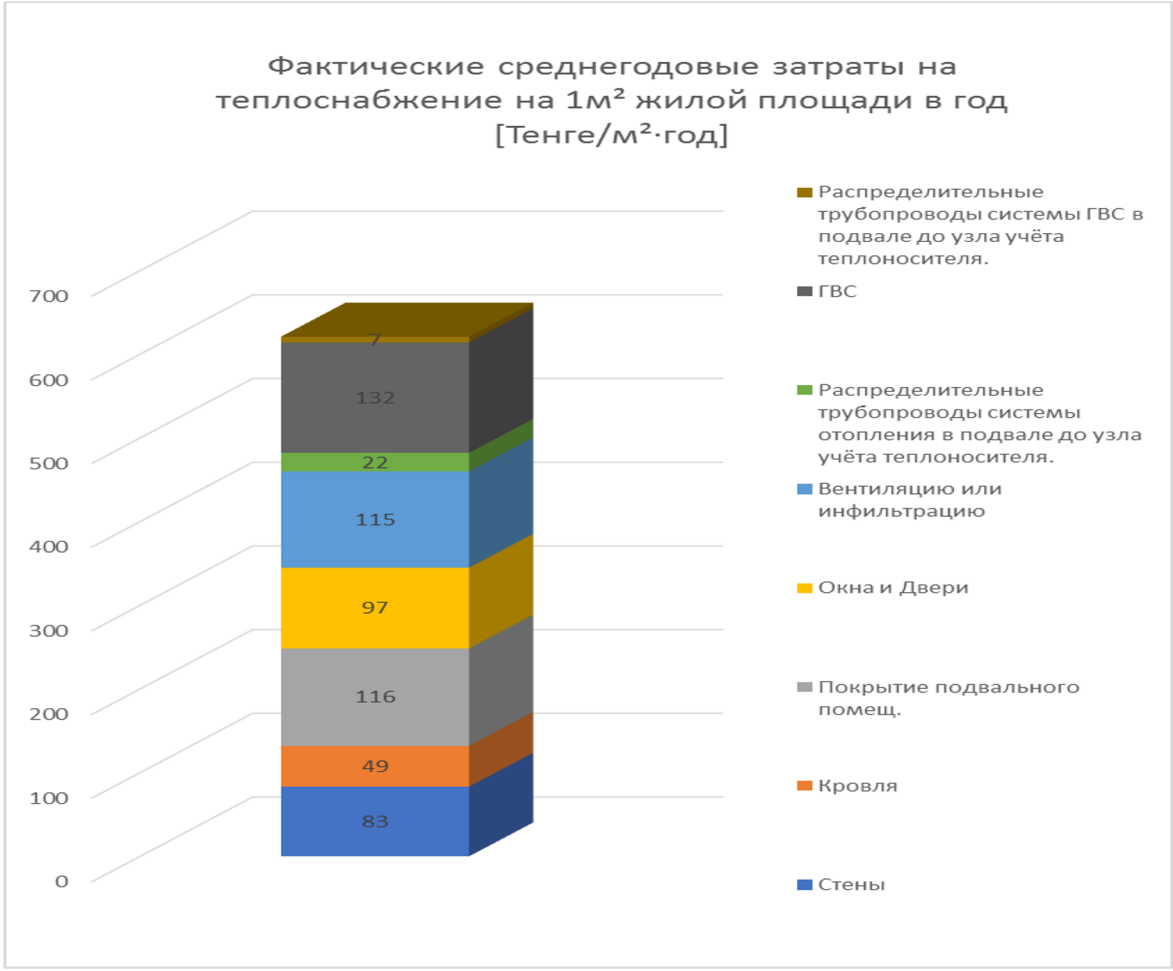
ACTIVITIES UNDER THE PILOT PROJECT

Наименование	Теплотехнические показатели стеновой панели			Теплотехнические показатели покрытия			Теплотехнические показатели перекрытия подвала		
	По СН РК	Факт	Эфф.	По СН РК	Факт	Эфф.	По СН РК	Факт	Эфф.
Сопротивления теплопередаче R, $(м^2 \cdot °C)/Вт$	3,60	1,19	3,3 раза или 67 %	5,34	0,98	5,5 раза или 82 %	3,55	0,41	8,6 раза или 88,4%
Коэфф. теплопередачи K, $Вт/(м^2 \cdot °C)$	0,28	0,84		0,19	1,02		0,28	2,43	
Коэфф. теплотехнической однородности r	0,95	0,6	1,6 раза	0,95	0,6	1,6 раза	0,95	0,9	-
Нормируемый темп. перепад Δt_n, °C	1,79 < 4	5,99 > 4	4,2 °C	1,21 < 3	7,28 > 3	6,08 °C	1,82 < 2	12,9 > 2	11,2 °C
Тепловой поток q, $Вт/м^2$	15,56	57,12	3,4 раза или 70,2 %	10,48	63,36	6 раза или 83,5 %	15,8	112,9	7,2 раза или 86,01%

Energy efficiency class – **E – low.** Deviation from norms **139%**

ACTUAL HEAT CONSUMPTION





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PROJECTS IN KAZAKHSTAN AND UZBEKISTAN

USE ENERGY AROUND YOU SOLARWAY

solarway.kz (+7 700 125 53 01)

Solar power plants for buildings and industry
Operate in Kazakhstan and Uzbekistan

7000 kW
Installed capacity

5000
Satisfied clients

500
Completed projects

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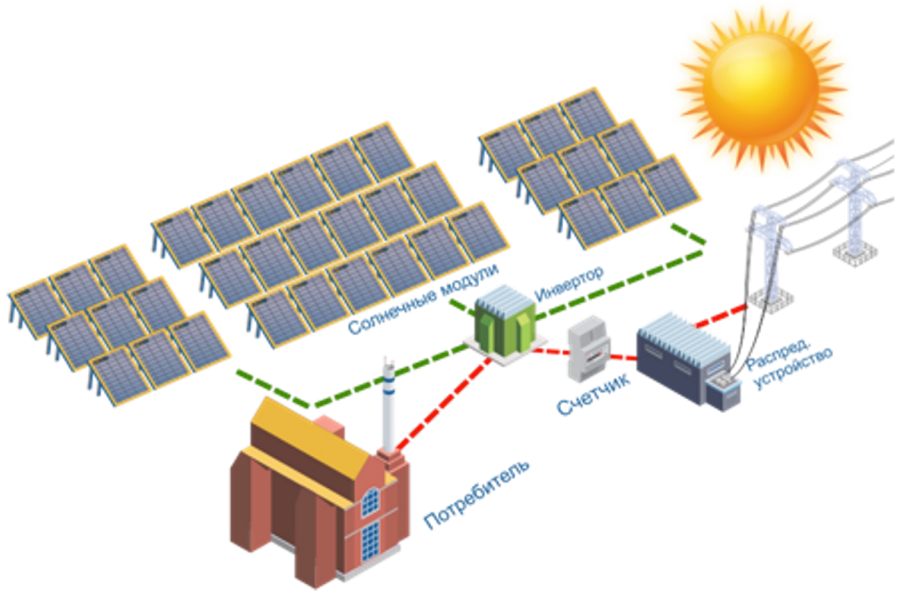
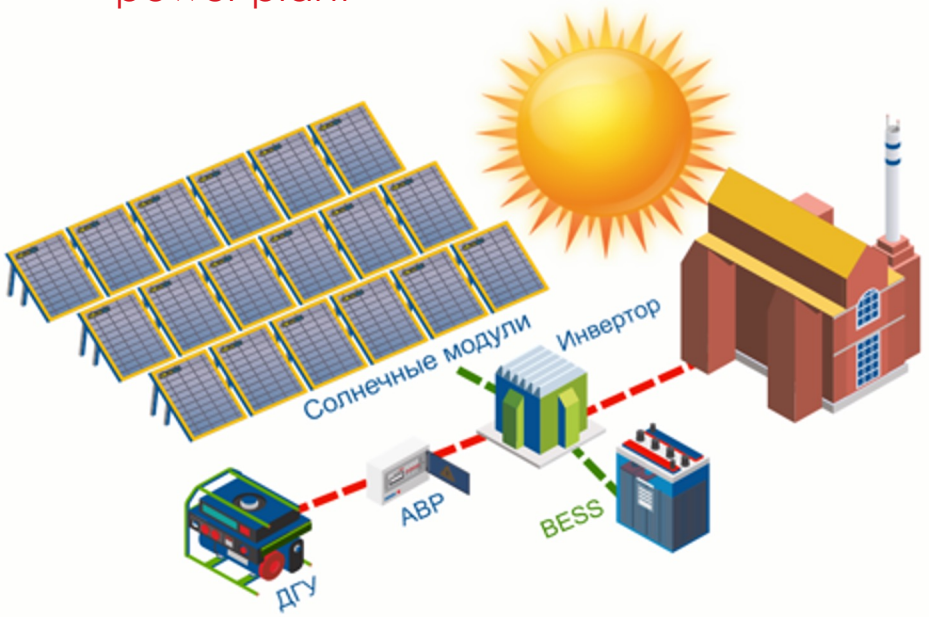
DIFFERENT SMALL RENEWABLE SYSTEMS FOR BUILDINGS

Installation of On-Grid systems for planned facilities



This involves generating energy for current consumption and exporting excess energy to the grid; in the future, this system can easily be upgraded with energy storage systems, which will make such facilities sustainable and autonomous.

Installation of a diesel hybrid solar power plant



During the day, solar panels generate electricity used for consumer needs and to charge the batteries of the energy storage system. If there is a shortage or absence of electricity from solar modules (in cloudy weather or at night), the autonomous solar power plant starts using energy from the battery and supply it to the consumer's network after converting it using an inverter, from direct to alternating current with the required voltage and frequency.

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DATA PROCESSING CENTER, ALMATY

Year of commissioning of the renewable energy facility: 2023
Capacity: 100 kW
Number of solar panels: 182 pcs
Power of one panel: 550 W (Risen)
Total cost: 30,000,000 KZT
Implementation period: from 11/22/2023 to 12/22/2023, 30 days
Number of installers: 6

Planned output: 128,425 kWh per year

Types of equipment:
Solar battery Risen - 182 pcs Growatt network three-phase inverter 25 kW - 4 pcs
Aluminum triangular design
Consumables
Installation work

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"BAK AGRO SERVICE" LLP GREENHOUSE FARM, SHYMKENT

Year of commissioning of the renewable energy facility: 2023
Capacity: 100 kW
Number of solar panels: 184 pcs
Power of one panel: 550 W (Eco Green Energy)
Total cost: 32,000,000 KZT
Implementation period: from 02/01/2023 to 02/20/2023, 20 days Number of installers: 5

Planned output: 145,000 kWh per year

Types of equipment:
Solar battery Eco Green Energy - 184 pcs
Network three-phase inverter Growatt 110 kW - 1 pc
Aluminum construction
Consumables. Installation work

The greenhouse currently fully covers its consumption and sells 70% of the electricity to the city grid.

Funded by the European Union

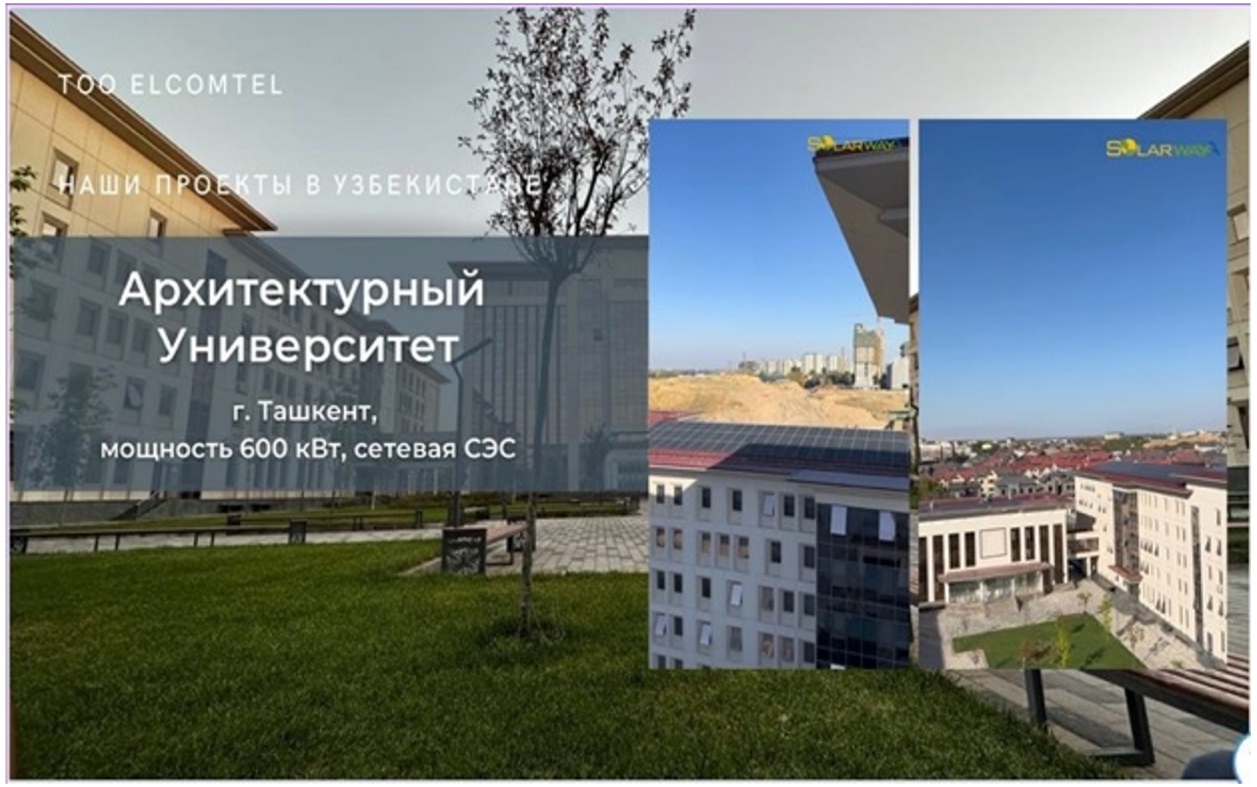
Tashkent Institute of Architecture and Civil Engineering

Year of commissioning of the renewable energy facility: 2023
Capacity: 600 kW
Number of solar panels: 1094 pcs
Power of one panel: 550 W (Jinko)
Total cost: $400,000 US
Implementation period: from 08/06/2023 to 08/15/2023, 9 days
Number of installers: 25

Planned output: 840,000 kWh per year

Types of equipment:
Solar battery Jinko - 1094 pcs
Network three-phase inverter Growatt 125 kW - 5 pcs
Aluminum construction
Consumables.
Installation work

The university covers up to 30% of electricity costs.



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LAW ON ENERGY SAVING

Law of the Republic of Kazakhstan dated January 13, 2012 No. 541-IV.

1) energy efficiency class of a building or structure - the level of efficiency of energy consumption of a building or a structure, characterizing its energy efficiency at the stage of operation;

2. The required energy efficiency class is indicated in the customer's assignment for the development of a construction project (reconstruction, overhaul) and is indicated in the technical passport of the constructed and commissioned facility when registerin rights to real estate after the completed construction (reconstruction, overhaul) facility is put into operation.

3. The energy efficiency class of existing buildings or structures and its revision is established in the manner determined by the authorized body , based on the results of an energy audit and indicated in the technical passport of the building, structure.

The conclusion of the energy audit is attached to the technical passport of buildings or structures.

4. Labeling of existing buildings, structures for energy efficiency is established based on the results of the energy audit and is indicated in the energy audit conclusion.

Requirements for energy efficiency do not apply to the following buildings, structures:

1) buildings, structures that are classified as objects of historical and cultural heritage;
2) temporary buildings for economic purposes, utility rooms, the service life of which is not more than two years;
3) individual residential houses, as well as buildings located in summer cottages and garden plots
4) detached buildings, structures with a total area of less than fifty square meters;
5) religious buildings and structures;
6) detached unheated buildings and structures.

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NEW OPPORTUNITIES FOR INDIVIDUAL HOMES

Powerwall +

>250 000

Powerwall systems around the world

System cost

in the USA- **$11 500**

Technical characteristics of the Powerwall+ system

Battery capacity
13.5 kWh

Mains power
7.6 kVA / 5.8 kVA (continuous)

Backup power
9.6 kW / 7 kW (continuous)
22 kW / 10 kW maximum load from external network
Maximum starting load – 118 A

Size and weight
-160 cm x 75 cm x 16 cm
- 156 kg

Inverter
Efficiency - 97.5%
Max. number of trackers for PV modules: 4

Installation
Built-in inverter and system controller
Bust and moisture resistant
Operating temperature range: -20 – +50 °C

* *Powerwall 1 – April 2015*
Powerwall 2 – October 2016
Powerwall+ – April 2021

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