Investment and Financial Flows (I&FF) Assessment Report

Assessment of investment and financial flows to address climate change mitigation in the sector Electricity Demand

Contents

1. Introduction

Consumption of electricity in 2009 amounted to 13.19 billion kwh, of which on their own power needs have 6,7% and the consumption of electricity in its transformation and transport 19.3%. Useful electricity to consumers in 2009 amounted to 12.08 billion kWh. [6]

The main consumer of power in Turkmenistan is a population, which accounts for 29,0% of the released energy, of which 14,8% of the population in urban and peri-urban and 14.2% for the rural population. [6]

Industry's share in total consumption is 19,4%. Construction accounts for 3.8% tempered electricity. Most of the consumption of electrical energy consumed by utilities in cities and rural settlements, which accounts for 8.9% of all the released energy. The share of street lighting in cities and towns account for 0,7% of electricity. [6]

In the electricity development program of Turkmenistan provides an annual growth of power consumption by 3-4% with finishing up 27.32 billion kwh in 2030, thus the demand for electricity in 2030 increased by 2,1 times compared to the year 2009. This will happen at the expense of building new industrial facilities and population growth in electricity consumption due to its increase and the growth of wealth, which would boost the purchasing power of people to buy more consumer products. [4]

In this paper some address questions to reduce the volume of electricity consumption in the population living quarters (housing sector) and consumers in other buildings departmental appointments (departmental sector). It should be noted that the population is the most energy-intensive consumer in Turkmenistan today

Questions reduce power consumption in the industry were not considered for the reason that the bulk of the industrial electricity consumption up new plants (oil refining, metallurgical, cement, carbamide, textile complexes and others), which were built in recent times with the use of new technologies and, presumably, are responsible modern requirements of energy efficiency.

1.1 Objectives

Assessment of investment and financial flows, primarily intended for national officials, policy makers of the country in the future.

The main objective of this work - to identify and describe the options for policies related to the solution to prevent climate change sector, Electricity demand, in other words, to assess the priorities for technological measures to improve energy efficiency in electricity consumption. Such actions will reduce emissions of greenhouse gases (GHG) emissions and, thus, will contribute to mitigate climate change. We also assessed the costs of implementing these measures.

To achieve this goal in the process of following tasks:

- Scoping of the sector
- Identification of measures to reduce GHG emissions in the sector
- Identification of investment and financial flows in the historical period (2000-2008)
- Identification of scenarios for the sector - the baseline and mitigation scenario
- Projection of investment and financial flows in the baseline and mitigation scenario (2009-2030)
- Comparison of the baseline scenario and mitigation scenario
- Assess feasibility of interventions to mitigate the sector Electricity demand.

1.2 Rationale

1.2.1 The previous tests conducted

In the preparation of the Second National Communication on UN Framework Convention on Climate Change, examined issues related to improving energy efficiency and reduce CO_2 emissions in the production and transportation of electricity. The problems of GHG emission reductions in electricity consumption is still not studied in detail. In this paper, the first attempt to identify high priority activities to increase technological efficiency in electricity consumption in Turkmenistan. [3]

We used data from the Programme of development of the electricity until 2020 and peer review before 2030:

- Annual growth in electricity production by 3-4% with finishing up 26.38 billion kwh in 2020 (growth in comparison with 2008 by 1,8 times) and up to 35.5 billion kWh in 2030 year (growth in comparison with 2008 by 2,4 times)
- Annual growth in personal consumption by 3-4%
- Annual growth in electricity exports by 8-10%.

After analyzing the consumption of electricity in the historical period, the experts noted that in the winter and summer consumption significantly more than in spring and autumn periods. Thus, it is concluded that substantial amounts of electricity during the winter period associated with the use of electricity for heating, and in the summer air conditioning. [6]

It should be noted that the residential sector is experiencing a significant disadvantage in providing a warm, even in Ashgabat, where significant numbers of dwellings connected to district heating, it works enough for several reasons (the poor condition of the external and internal heating networks, etc.), so people are forced to employ various appliances for heating.

In rural areas, also with the onset of cold weather people use electrical appliances for heating. This situation is observed with heating, not only for accommodation, but also industrial buildings, where the most reliable source of heat at the present time is electricity.

Given that the efficiency of electricity production in the most modern power plants is about 60%, power plants in Turkmenistan - 30%, and the efficiency of gas boilers used for heating is 95%, and experts are invited to improve the heating of residential and industrial premises from the gas boiler and thereby reduce the inefficient consumption of electricity in the winter. [6,12]

Due to hot climate in summer for air conditioning both residential and industrial premises used by air conditioners. The analysis of air-conditioners imported in Turkmenistan, has shown that delivered, mostly air-conditioners with low energy efficiency, which are cheaper than energy-efficient air conditioners.

Since according to the standard, the improvement of energy efficiency of air conditioners Class A / B is 20% compared with the middle class, to reduce power consumption in the summer, it is proposed to re-use in air conditioners no lower than class B and gradually replace the existing air-conditioning for new high-class efficiency.

Much of the electricity used effectively throughout the year, we have also the lighting of buildings. Given that in recent years in the world have developed different types of energy-saving bulbs, saving up to 80% of electricity [10], experts are encouraged to implement over the next five years, replacing incandescent light bulbs used in both the population and the industrial sphere. Replace incandescent light bulbs with energy saving will save annually about 11 billion kilowatt-hours for electricity, which represents 7% of the electricity produced in 2009.

Thus, the main activities to build energoeffektvnogo electricity, affecting the reduction of CO_2 emissions in the sector Electricity demand, defined as follows:

- Replacing incandescent light bulbs with energy saving lamps
- Replacement of air-conditioners air conditioners with energy efficiency class B and above
- Replacement of electrical appliances used for heating, gas-fired boilers.

It should be noted that the choice of these activities and the construction of the scope of the sector affected by the following factors:

- Use of electric light bulbs, air conditioners and electrical appliances for heating has a very large potential for energy savings
- As a result of activities is achieved on the guaranteed energy savings, which can be easily verified
- To achieve significant energy savings can be applied widely applied in world practice, effective tools to implement energy savings, reduce greenhouse gas emissions, as well as providing significant financial benefits for the country
- Implementation of these activities require a change in behavior by the community of consumers and allow the Government to introduce requirements for the performance characteristics of imported electrical goods, instead of prescribing specific technologies.

1.2.2 Institutional arrangements and collaboration

Score I&FF and O&M in the sector Electricity demand conducted with the support of key ministries for this sector - the Ministry of Energy and Industry of Turkmenistan and its subdivisions of the State Concern Turkmenenergo.

The main group of experts to assess I&FF in the sector Electricity demand is presented by officials and experts of the Ministry of Energy and Industry. It should be noted that the experts have been appointed officially by the Ministry in response to a request from the UNDP Resident Representative in Turkmenistan.

In the first phase of the project managers of the project was organized by the expert group meeting with international experts, which the team agreed on procedures to provide data for analysis and approval of final sectoral report by the Ministry of Energy and Industry.

To fulfill the objectives of the project, agreed to use the following data from the annual reports of power grid enterprises and the State Energy Supervision: The number of electricity used by month, by year for each province (region) and for the city of Ashgabat, as well as financial cost for the calculation I&FF and O&M .

In implementing the objectives of the project experts group worked closely with all the power suppliers to refine the data of annual reports and gather additional information.

In order to determine the number of bulbs used by the experts group organized visits to selected apartments, houses, industrial buildings in the provinces and Ashgabat. Based on the obtained results showed the actual number of bulbs used for different categories of consumers.

Also, the experts used data from the technical documentation of the existing boiler, generating heat energy for heating (boiler efficiency, unit cost of fuel to produce 1 Gcal of heat energy), and also made a visual inspection of equipment for sample boiler.

In order to specify the data for the construction and operation of the existing boiler boiler experts interacted with industrial associations Ashgabatteplo, Maryteplo, Directorate of Joint boilers and heat networks of cities Balkanabat and Turkmenbashi, as well as power plants, which together with the electricity is produced by heat: Mary HPP Seidi CHP, Turkmenbashi thermal power station, hydroelectric Abadan.

To assess the CO_2 emissions group agreed to use the unit cost of fuel to produce 1 kWh of electricity derived from technical reports of power. [6]

As the assumptions for assessing I&FF expert group used the following information:

- The cost of incandescent lamps, air conditioners with energy efficiency class and lower middle appliances for heating taken according to the local consumer market as of December 2009.
- Cost of energy-efficient air conditioners and energy-efficient lamps are based on data provided by the international expert of the project.
- From the master plan and feasibility study for the cities of Turkmenistan, which is the result of the UNDP Project Development Strategy of the district heating system in 2006, the following data: the value of 1 Gcal of heat energy, the cost of heating gas boiler, the cost of 1 km of heating, the cost of boiler operator training.

To coordinate the work of the meeting of experts held every two weeks, starting from September 1, 2009, after gathering all the information - if necessary, but not less than once a month.

1.2.3 Basic methodology and key terms

On the basis of reviewing the development of the electricity of Turkmenistan until 2020, the new edition of which was developed in December 2008 and is currently in negotiation and approval by the Government of Turkmenistan, have developed two scenarios: baseline and mitigation scenario for the sector Electricity demand.

Baseline scenario. This scenario assumes that consumption growth will occur in line with the Programme of development of the electricity until 2020 and the expert analysis of growth in consumption until 2030.

The baseline scenario assumes that the reduction in specific energy consumption and hence CO_2 emissions will occur, even when replacing incandescent light bulbs for energy-efficient does not happen more quickly, as planned in the mitigation scenario. Such a change will happen anyway, but later and for a longer period, resulting in the cessation of production of filament lamp manufacturers and re-profiling the production of energy-saving lamps. According to expert assessment of this will happen in the years 2020-2030. Thus, during this time will be a spontaneous replacement of incandescent light bulbs with energy saving lamps.

Reduction of specific energy consumption for activities associated with air conditioning and heating, will not happen, so the reduction of CO_2 emissions from these activities taken at the zero level. It is assumed that the country will begin to romp cheaper and therefore more energy-intensive air-conditioning, in addition, at the continuing deterioration of heating systems each year will increase consumption of energy for space heating. This will also contribute to the fact that the electricity tariff will remain relatively low for local consumers.

Mitigation scenario. This scenario assumes that the reduction in CO_2 emissions will occur as a result of all three events:

- Replace incandescent light bulbs with energy saving
- Replacement of existing air conditioners for energy efficiency
- Replacement of electric heating with gas boiler.

Reduce CO_2 emissions by replacing incandescent lamps rated as follows:

- Determine the number of incandescent lamps in the departmental and residential sectors, as well as the amount of electricity consumed by these bulbs.
- Given the fact that modern energy-saving lamps can save 80% energy, determined energy savings by replacing incandescent light bulbs with energy saving.
- Applying the rate of specific fuel consumption (gas) to the amount of electricity saved, received the amount of the saving of fuel by replacing incandescent light bulbs with energy saving.

- Applying the factor of CO_2 emissions for combustion of natural gas to the amount of the saving of gas, obtained emission reduction of CO_2. replacing incandescent light bulbs with energy saving.

Reduce CO_2 emissions by replacing energy-saving air conditioners rated similarly, but with the difference that the energy-saving air conditioner saves 20% electricity.

Reduce CO_2 emissions by replacing electric heaters for heating with gas boiler is defined as follows:

- Estimate the number of electrical appliances for heating, consumption of electricity and the amount of gas needed to produce this electricity.
- Determine the number of heat equivalent to consumption of electrical energy used for heating, and the amount of gas needed to produce this heat to gas-fired boiler.
- The quantity of the saving of fuel as the difference between fuel needed to generate electricity consumption for heating and fuels needed to heat production at the gas boiler.
- Applying the factor of CO_2 emissions for combustion of natural gas to the volume of the saving of gas, obtained volume reduction of CO_2 emissions by replacing electric heating with gas boiler.

Replace incandescent light bulbs with energy saving will save annually about 1.1 billion kwh of electricity.

Replacement of existing air conditioners for energy efficiency will save annually about 100 mln.kVt.ch electricity.

Replacing electric heating with gas-fired boilers will in 2030 to save about 2.5 billion kwh of electricity.

Thus, as a result of activities on the mitigation scenario would be no need to build two gas turbine power plant steam cycle gas until 2030, provided for in the mitigation scenario for the sector Production of electricity.

For the calculations in both scenarios used official documents:

- Master plan and feasibility study for the cities of Turkmenistan. The development strategy of the district heating, UNDP, Ashgabat, 2006;
- Second National Communication under UN Framework Convention on Climate Change. Ashgabat, 2009;
- National Programme for the development of power industry of Turkmenistan until 2020;
- Expert assessment of power development of Turkmenistan for 2021 - 2030 years;
- Annual reports of industrial electric transmission organizations, the State Enterprise for electricity surveillance and HES Turkmenenergo;
- Reference book on the energy third edition, revised and enlarged Moscow, Energia, 1978;
- Handbook on designing power systems Second Edition, revised and enlarged Moscow-Energy, 1977;
- Handbook of electrical installations of high voltage, Second Edition, revised and supplemented, Moscow, Energoizdat, 1981.

Investment Flow (IF) - This capital cost:

- Purchase of incandescent light bulbs, air conditioners and electrical appliances for heating in the baseline scenario.
- Purchase of energy-saving lamps, energy-efficient air conditioners and the construction of gas-fired boiler for heating instead of using electrical appliances for heating in the mitigation scenario.

Financial Flow (FF) - is the current costs of program activities, staff training, the cost of workshops, dissemination of popular literature, the training of new personnel and retraining of existing staff.

The cost of operation and maintenance (O&M) - are operating expenses, which include:

- Raw materials

- Payment for water
- Production services, repairing
- Fuel
- Energy
- Fund pay
- Deductions for social insurance
- Payment for environmental
- Other.

2. Scope, the input data and scenarios

2.1 Scope of the sector

The structure of energy supply enterprises of Turkmenistan consists of six industrial associations electric grid, divided on a territorial basis, that is, in each province (region) has a production association of electrical networks, and one interconnection of electric networks is in Ashgabat. [6]

The main function of industrial associations of electrical networks is the distribution elektoenergii received from power plants, according to the grid voltage from 0,4 ÷ 500 kV to energy consumers. Raises funds for sold electricity state enterprise engaged in oversight of the electricity and selling electricity, which has branches in every province (oblast) and district (area).

In the sector of electricity demand is used 86% of the electricity produced in Turkmenistan (14% of electricity is exported). Based on this we can conclude that the reduction of CO_2 emissions from electricity production depends on improving energoeffnetivnosti as a sector electricity production and the sector electricity demand.

Analysis of electricity consumption by consumer groups shows that the highest consumption of electricity has on the population, whose share in total consumption is 29% [6]. Considering the power consumption on the activities, we can conclude that both the consumer - residential and departmental sectors make heavy use of electricity for air conditioning, heating and lighting.

Therefore, the scope of the assessment I&FF and G include these activities, and paid particular attention to identifying activities that are on the expert opinion, which will significantly reduce power consumption and, consequently, reduce CO_2 emissions.

Of course, it is necessary to carry out a number of other measures for the rational use of energy, such as alignment chart loads, reducing power consumption for its transformation and transport and others. However, these measures do not give a significant reduction in CO_2 emissions and therefore in this study were not considered.

With regard to investment organizations, it should be noted that the costs incurred by the sector Electricity demand includes both public and private funds needed to purchase incandescent air conditioners, electrical appliances for heating, and only public funds for the construction of gas-fired boiler and heating mains.

2.2. Input data and scenarios

2.2.1 Assessment period and cost accounting parameters

The assessment period includes the historical period 2000-2008 year, as well as long-term period 2009-2030 years.

The base year adopted in 2008, since mid-2008 has been changed in the direction of the dollar is a significant increase compared with the previous period 2000-2007. Thus, in 2008, the cost-oriented, which is traditionally calculated in national AZM significantly reduced when converted into U.S. dollars. On the basis of cost-oriented in 2008 were estimated expenditure for 2009-2030 O&M years, and then translated into U.S. dollars. According to expert opinion in 2008 as the base reflects the actual costs of O&M in U.S. dollars in subsequent years until 2030. IF and FF were calculated directly in U.S. dollars, so the choice of these indicators did not affect the base year.

Until May 2008 the official dollar exchange rate was 5200 manat, but from May 2008 - 14250 manat or 2,82-denominated manat. [13]

In accordance with the existing practice of designing and in consultation with international experts of this work, the discount rate adopted at the 10% level.

2.2.2 Method of analysis

The historical period before the figures for 2000-2009. Data on consumption of electricity during this period are taken from the annual reports of industrial associations and by calculation determines the volumes of CO_2 emissions.

Data on electricity consumption in the baseline scenario to 2030 were obtained from the program of power sector development to 2020 and according to expert opinion of power consumption growth in the years 2021-2030. The baseline scenario assumes that conditioning will be used air conditioners middle class, and will be used for heating appliances for heating, and their number from year to year will increase. Replace incandescent light bulbs with energy saving in the baseline scenario will be carried out with 2021 and 2030 due to the expected termination of the production of incandescent lamps.

Due to the fact that it was unable to obtain reliable data on I&FF and O&M for the historical period, these data are determined by calculation. This estimated annual purchased lamps, on the basis of their service life (1000 hours), as well as the annual volume purchased air conditioners and electrical appliances for heating, taking into account depreciation rates for the full recovery of funds of the national economy of Turkmenistan to be 4% per year.

To calculate the IF in the historical period and the baseline scenario adopted by the price of 1 bulb - 0,2 U.S. $, 1 air conditioner - $ 400, an appliance for heating - U.S. $ 53.

To calculate the IF in a scenario taken to mitigate the cost of an energy-saving lamps - $ 2 [10], an air conditioner - $ 500, 1 Gcal of heat - 40 thousand dollars, about 1 km. heating - 1,4 million U.S. dollars.

I&FF in the historical period and baseline scenario are equal to 0, as funds for training on the application of incandescent lamps, air conditioners and electrical appliances for heating is not allocated.

I&FF for the mitigation scenario were identified only for departmental sector, based on the need for training of personnel involved servicing gas boilers for heating. In the residential sector funds for training are not provided.

O&M in the historical period in the baseline scenario and mitigation scenario for incandescent and energy-saving lamps in the residential sector are equal to 0, given that 35 kWh electricity per person per month is released for free.

The calculation of O&M for the historical period and in the baseline scenario for the replacement of incandescent lamps, air conditioning and electric heating in the public sector was carried out according to the amount of electricity with the use of tariffs, taking into account the VAT rate on electricity: 0,92 m. or 3,228 • 10-3 U.S. Dollar for 1 kWh for the residential sector and 1.2 m. or 4,211 • 10-3 USD per 1 kWh for departmental sector. Also, for the calculation of O&M accepted the cost of repairing air conditioners and electrical appliances for heating, equal to 2% of the annual IF.

The calculation of O&M for the replacement of incandescent lamps and air conditioners in the departmental sector in the mitigation scenario produced similar baseline scenario taking into account the decline in electricity consumption from these activities.

The calculation of O&M for the boiler in the mitigation scenario for the departmental sector is made on the basis of a master plan and feasibility study for the cities of Turkmenistan (Development Strategy of the district heating UNDP, Ashgabat, 2006). [12]

O&M for private sector residential boilers in the mitigation scenario are equal to 0, since the gas is released to the population free of charge. With the improvement of heating gas boiler and non-use of electrical appliances for heating in the residential sector-oriented every year will decrease the value of reducing the cost of electricity for heating.

2.2.3 Historical IF, FF and O&M data, as well as subsidies

From the annual report for 2000-2008 provided data on consumption of electricity in Turkmenistan. According to these data, in the winter months (January, February, November and December), summer (June, July, August and September), power consumption is significantly higher than in autumn and spring periods. This is because in the summer of electricity used for air conditioning in connection with a hot climate, and in winter for heating.

By applying the unit cost of fuel for electricity generation and the rates of CO_2 by burning natural gas to the volume of electricity consumed, determined the amount of natural gas used to produce the actual power consumption and emissions in CO_2 equivalent.

As noted above, historical data on I&FF and G were calculated (expert) method. As an assumption made that the number of incandescent lamps, air conditioners and electrical appliances for heating increased annually by 4% in 2000-2009. With this in mind, we calculated annually purchased bulbs in the historical period (2000-2008) a countdown of the estimated amount for 2009 in the baseline scenario. The results of the IEF for incandescent lamps in the residential and public sectors identified the product of the number of newly acquired bulbs and their market value, which is set equal to 0.2 U.S. dollar.

Similarly, entrepreneurs are defined for air conditioners and electrical appliances for heating according to their market value equal to respectively 400 and U.S. $ 53.

Financial Flows in the historical period taken equal to 0 in the absence of training for the use of incandescent lamps, air conditioners and electrical appliances for heating.

O&M for incandescent lamps in the residential sector are taken to be 0, because under the legislation of Turkmenistan 1935 kWh of electricity per person per month is released free of charge. O&M for incandescent lamps in the departmental sector are estimated as the product of the annual electricity consumption filament and the average tariff for electricity for SOEs equal to 1.2 m. or 4,211 • 10-3 USD per 1 kWh.

O&M air conditioning and heating appliances are defined as the sum of the cost of repair of these devices and the cost of electricity costs. Repairs of air conditioners and electrical appliances for heating taken at a rate of 2% of the annual IF.

Energy costs are based on annual volume of electricity consumption for air conditioning and electric heating and electricity rates, equal to 0,92 m. or 3,228 • 10-3 USD per 1 kWh for the residential sector, 1.2 m. or 4,211 • 10-3 USD per 1 kWh for departmental sector.

Data analysis I&FF and O&M in the historical period shows that the O&M for the replacement of air conditioners and electrical appliances for heating varies in steps, as in some years have witnessed a decrease in O&M compared with the previous year is explained by the fact that the weather in winter and summer months varies from years. There are years with very cold winters and very hot summer, in such years, spiking growth in electricity consumption for heating and air conditioning and as a consequence of an increase in O&M. However, despite the power consumption peaks can be noted the tendency of constant growth in demand for electricity for heating and air conditioning.

Historical period: IF, FF and O&M in terms of customer and types of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps						Replacement of air conditioners for energy-efficient air conditioners						Replacing electric heating with gas boiler					
	Residential			Departmental sector			Residential			Departmental sector			Residential			Departmental sector		
Year	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M
2000	1,092	0	0	0,42	0	1,589	1,427	0	0,449	0,173	0	0,14	0,359	0	1,677	0,193	0	1,181
2001	1,138	0	0	0,438	0	1,655	1,486	0	0,417	0,181	0	0,13	0,374	0	1,731	0,201	0	1,219
2002	1,185	0	0	0,456	0	1,724	1,548	0	0,747	0,188	0	0,237	0,389	0	2,051	0,209	0	1,443
2003	1,234	0	0	0,476	0	1,796	1,613	0	0,400	0,196	0	0,124	0,406	0	2,055	0,219	0	1,446
2004	1,286	0	0	0,496	0	1,870	1,680	0	0,552	0,204	0	0,173	0,423	0	1,901	0,228	0	1,338
2005	1,339	0	0	0,516	0	1,948	1,750	0	0,637	0,212	0	0,200	0,440	0	2,076	0,237	0	1,461
2006	1,395	0	0	0,538	0	2,029	1,823	0	1,020	0,221	0	0,325	0,459	0	2,084	0,247	0	1,467
2007	1,453	0	0	0,560	0	2,114	1,899	0	0,885	0,231	0	0,281	0,478	0	2,181	0,257	0	1,535
2008	1,514	0	0	0,583	0	2,202	1,978	0	1,002	0,240	0	0,319	0,498	0	2,653	0,268	0	1,866
2009	1,577	0	0	0,607	0	2,294	2,060	0	1,254	0,250	0	0,401	0,518	0	3,170	0,279	0	2,230
Total	13,213	0	0	5,090	0	19,221	17,264	0	7,363	2,096	0	2,330	4,344	0	21,579	2,338	0	15,186

For categories - Residential, Investment Organization - Private owners; Sources I&FF funds - Domestic private funds
For the category - Departmental sector; Investment Organization - Government; Sources I&FF funds - Internal budget

Historical period: total IF, FF and O&M types of investment activity for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps			Replacement of air conditioners for energy-efficient air conditioners			Replacing electric heating with gas boiler			Total costs for all activities		
	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M
2000	1,512	0	1,589	1,600	0	0,589	0,552	0	2,858	3,664	0	5,036
2001	1,576	0	1,655	1,667	0	0,547	0,575	0	2,950	3,818	0	5,152
2002	1,641	0	1,724	1,736	0	0,984	0,598	0	3,494	3,975	0	6,202
2003	1,710	0	1,796	1,809	0	0,524	0,625	0	3,501	4,144	0	5,821
2004	1,782	0	1,870	1,884	0	0,725	0,651	0	3,239	4,317	0	5,834
2005	1,855	0	1,948	1,962	0	0,837	0,677	0	3,537	4,494	0	6,322
2006	1,933	0	2,029	2,044	0	1,345	0,706	0	3,551	4,683	0	6,925
2007	2,013	0	2,114	2,130	0	1,166	0,735	0	3,716	4,878	0	6,996
2008	2,097	0	2,202	2,218	0	1,321	0,766	0	4,519	5,081	0	8,042
2009	2,184	0	2,294	2,310	0	1,655	0,797	0	5,400	5,291	0	9,349
Total	18,303	0	19,221	19,36	0	9,693	6,682	0	36,765	44,345	0	65,676

2.2.4 Baseline scenario

The data for the forecast of domestic consumption of electricity in the baseline scenario in the years 2010-2020 were obtained from the Programme of development of the electricity until 2020, in the years 2020-2030 adopted by the data of the expert assessment based on analysis of consumption by 2020.

On the basis of domestic consumption of electricity, gas flow rate relative to produce 1 kWh, and the coefficient of CO_2 emissions by burning the gas obtained gas consumption and the amount of CO_2 emissions from electricity consumption over the years in the baseline scenario.

Replace incandescent light bulbs with energy saving lamps

Because if you do not produce consistently in the coming years, replacing incandescent light bulbs with energy saving, it will happen spontaneously in connection with the withdrawal from the production of incandescent lamps. According to expert assessment in Turkmenistan, this substitution occurs in the years 2020-2030. Amount of CO_2 emissions in the baseline years of 2021-2030 reduced the amount of emission reductions from replacing incandescent light bulbs with energy saving.

A total of Turkmenistan has 904,918 residential subscribers and 35,662 other consumers of electricity (ministries, agencies, industry, transport, agriculture and others). To determine the average number of lamps per one customer in the residential and departmental sectors within the framework of this study a survey was conducted in all districts (districts) for 10 customers in each sector.

Given the estimated number of lamps and the number of subscribers to determine the total number of lamps used in the residential sector - 8.053 million units, the departmental sector - 3.103 mln Also, the determined power of all lamps equal 748.1 MW in the residential sector, and 270.3 MW in the departmental sector. Assuming that each incandescent lamp used for about 3 hours a day, estimated annual consumption of electricity incandescent lamps, which for the residential sector is 819.2 mln.kVt.ch for departmental - 544.8 mln.kVt.ch.

The I&FF assessment for use of incandescent lamps in the baseline scenario, adopted the life of incandescent lamps 1000 hours, presumably as a daily average incandescent lamp uses 2.7 hours, thus the life of incandescent lamps is 1 year. To determine the annual number of replacement bulbs into account the fact that 2% of lamps to be replaced in addition to the injury as a result of their marriage, and power surges. IF incandescent obtained on the basis of the annual number of replacement bulbs and their market value of 0.2 U.S. dollar.

According to expert opinions, in the years 2021-2030 in connection with the cessation of production of incandescent lamps will be their replacement for energy-saving lamps in the amount of 10% per year. In this case, the IF calculations take into account the market value of energy-saving lamps in the amount of U.S. $ 2, and the fact that the remaining 90% of bulbs will be replaced annually, while the energy-saving lamps 1 time in 10 years, as their average lifespan is 10,000 hours or 10 years. [10]

Financial Flows incandescent taken to be 0, since costs for training on the use of these lamps is not planned.

O&M for incandescent lamps in the residential sector also taken equal to 0, because under the legislation of Turkmenistan 1935 kWh of electricity per person per month is released free of charge. O&M for incandescent lamps in the departmental sector based on annual consumption of electricity incandescent lamps in the public sector and the average tariff for electricity for the state-owned enterprises equal to 1.2 m. or 4,211 • 10-3 USD per 1 kWh.

Replacement of air conditioners for energy-efficient air conditioners

Replacing electric heating with gas boiler

The baseline scenario assumes that conditioning will be used air conditioners of the middle class, while for the heating appliances used for heating, with the number of air conditioners and electric heating appliances for each year will increase, and consequently will increase the demand for electricity.

Electricity consumption in summer is much higher than in autumn and spring. This is due to the use of air conditioners in the home (residential sector) and companies (departmental sector).

Air conditioners are used in Turkmenistan, mainly in June, July, August and September. Total electricity consumption for air conditioning for the year 2009 is estimated as the difference between the maximum values of electricity consumption in these months and the average values in spring and autumn. According to experts 80% of electricity consumption for air conditioning accounts for the residential sector, 20% for departments.

Quantity of electricity consumed for the years 2010-2030 to obtain an increase of annual consumption in the residential sector in the years 2010-2015 by 4% in the years 2015-2020 to 3% in 2020-2025 to 2.5% in 2025-2030 years 2%. It is suggested that an increase in welfare in the first five years will be more intense than the purchase of air conditioners in the coming years, because as saturation and air conditioners will be bought in smaller quantities.

Power consumption for the years 2010-2030 in the departmental sector will not increase as rapidly as in the residential sector. Therefore, the adopted annual growth in electricity demand at 1%, which is characterized mainly the introduction of new public enterprises.

For the calculations made the assumption: the power of a 3 kW air-conditioning, while daily use of air conditioners in the residential sector - 15,5 hours (since the arrival of man home from work until leaving for work), the departmental sector - 8 pm (office hours). When to Use an air conditioner with a rated capacity for the year is estimated at 60 days. According to these data to determine the average annual consumption is a conditioning for both categories of users:

- In the residential sector - 2800 kWh
- The departmental sector - 1440 kWh.

Number of air conditioners in the residential sector are estimated as the total private consumption of electricity and an air-conditioning electricity consumption in the residential sector. Similarly, we define the number of air conditioners in the departmental sector. The annual increase is equal to the difference in the total number of air conditioners this year and the total number of air conditioners last year.

Total electricity consumption for heating in 2009 defined the difference between the maximum values of electricity consumption in winter months and the average values in spring and autumn.

After analyzing the increase in electricity consumption in the historical period, made the assumption that the growth of electricity for heating in the years 2010-2015 will amount to 3%, then the extent of saturation will be reduced in the 2016-2020 period to 2.5%, while in 2021-2030 period to 2%. On this basis, a calculation of energy consumption for heating for the years 2010-2030. The annual number of newly purchased appliances for heating is defined as the quotient of the annual electricity consumption for heating and electricity consumption an appliance for heating of 1 kW per year, used 120 days a year.

Based on the assumption that 65% of heating occur in the residential sector and 35% at the departmental, to assess the annual energy consumption in residential and departmental sectors and the annual quantity purchased new appliances for heating. [12]

IF-conditioning and electric heating are based on the number of annually purchased air conditioners and electrical appliances for heating and their market value, which is equal to 400, respectively, and $ 53.

Financial Flows for conditioning and electric heating are equal to 0, because the allocation of funds for training for these activities is not provided.

O&M air conditioning and electric heating have been evaluated as the sum of the cost of repair of these devices and the cost of electricity costs. The cost of electricity determined on the basis of annual electricity consumption for air conditioning / electric heating and electricity rates, equal to the residential sector 0,92 m. or 3,228 • 10-3 USD per 1 kWh, and for departmental sector 1,2 m. or 4,211 • 10.03 USD per 1 kWh

Analysis of the results I&FF and G by type of investment activity in the baseline scenario shows that most funds are spent on electricity costs for heating. Also, there are high costs to pay for electricity for air conditioning, despite the fact that the cost of electricity for local consumers is quite low. And the cost of O&M incandescent commensurate with the cost of IF, given that the residential sector electricity for this purpose is dispensed free of charge and energy costs are assumed to be equal to 0. Costs for electric heating is much higher than the cost of IF even with the low electricity tariffs. From this we can conclude that the reduction of inefficient energy use, as provided in the mitigation scenario is economically feasible.

Baseline scenario: IE, PT and O&M in terms of customer and type of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps						Replacement of air conditioners for energy-efficient air conditioners						Replacing electric heating with gas boiler					
	Residential			Departmental sector			Residential			Departmental sector			Residential			Departmental sector		
Year	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M
2008	1,514	0	0	0,583	0	2,202	1,978	0	1,002	0,240	0	0,319	0,498	0	2,653	0,268	0	1,866
2009	1,643	0	0	0,633	0	2,294	4,147	0	1,296	1,302	0	0,422	0,517	0	3,170	0,278	0	2,225
2010	1,643	0	0	0,633	0	2,295	4,379	0	1,349	1,315	0	0,426	0,540	0	3,265	0,291	0	2,292
2011	1,643	0	0	0,633	0	2,295	4,465	0	1,401	1,317	0	0,430	0,557	0	3,363	0,300	0	2,361
2012	1,643	0	0	0,633	0	2,295	4,554	0	1,455	1,320	0	0,434	0,573	0	3,464	0,309	0	2,431
2013	1,643	0	0	0,633	0	2,295	4,647	0	1,512	1,323	0	0,438	0,590	0	3,568	0,318	0	2,504
2014	1,643	0	0	0,633	0	2,295	4,744	0	1,570	1,325	0	0,442	0,608	0	3,675	0,327	0	2,579
2015	1,643	0	0	0,633	0	2,296	4,844	0	1,631	1,328	0	0,446	0,626	0	3,785	0,337	0	2,657
2016	1,643	0	0	0,633	0	2,296	4,270	0	1,666	1,331	0	0,451	0,538	0	3,878	0,290	0	2,722
2017	1,643	0	0	0,633	0	2,296	4,331	0	1,714	1,334	0	0,455	0,551	0	3,975	0,297	0	2,790
2018	1,643	0	0	0,633	0	2,296	4,394	0	1,765	1,336	0	0,459	0,565	0	4,074	0,304	0	2,860
2019	1,643	0	0	0,633	0	2,296	4,459	0	1,816	1,339	0	0,464	0,579	0	4,176	0,312	0	2,931
2020	1,643	0	0	0,633	0	2,297	4,525	0	1,869	1,342	0	0,468	0,594	0	4,280	0,320	0	3,005
2021	3,121	0	0	1,203	0	2,297	4,200	0	1,907	1,345	0	0,473	0,487	0	4,364	0,262	0	3,064
2022	2,957	0	0	1,139	0	2,297	4,250	0	1,954	1,348	0	0,477	0,496	0	4,451	0,267	0	3,125
2023	2,793	0	0	1,076	0	2,297	4,300	0	2,002	1,351	0	0,482	0,506	0	4,540	0,273	0	3,187
2024	2,628	0	0	1,013	0	2,297	4,352	0	2,051	1,354	0	0,486	0,516	0	4,631	0,278	0	3,251
2025	2,464	0	0	0,950	0	2,298	4,405	0	2,101	1,357	0	0,491	0,527	0	4,723	0,284	0	3,316
2026	2,300	0	0	0,886	0	2,298	4,014	0	2,133	1,360	0	0,496	0,537	0	4,818	0,289	0	3,382
2027	2,136	0	0	0,823	0	2,298	4,049	0	2,175	1,363	0	0,500	0,548	0	4,914	0,295	0	3,450
2028	1,971	0	0	0,760	0	2,298	4,086	0	2,217	1,366	0	0,505	0,559	0	5,012	0,301	0	3,519
2029	1,807	0	0	0,696	0	2,298	4,123	0	2,261	1,369	0	0,510	0,570	0	5,113	0,307	0	3,589
2030	1,643	0	0	0,633	0	2,299	4,161	0	2,305	1,372	0	0,515	0,582	0	5,215	0,313	0	3,661
Total	45,048	0	0	17,358	0	52,723	97,675	0	41,152	29,738	0	10,587	12,666	0	95,107	6,820	0	66,769

For categories - Residential, Investment Organization - Private owners; Sources I&FF funds - Domestic private fund

For the category - Departmental sector; Investment Organization - Government; Sources I&FF funds - Internal budget

Baseline scenario: summary IF, FF and O&M types of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps			Replacement of air conditioners for energy-efficient air conditioners			Replacing electric heating with gas boiler			Total costs for all activities			Total discounted costs		
	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M
2008	2,097	0	2,202	2,218	0	1,321	0,766	0	4,519	5,081	0	8,042	5,081	0	8,042
2009	2,276	0	2,294	5,448	0	1,717	0,795	0	5,395	8,519	0	9,406	7,745	0	8,551
2010	2,276	0	2,295	5,694	0	1,775	0,831	0	5,557	8,801	0	9,626	7,274	0	7,955
2011	2,276	0	2,295	5,783	0	1,831	0,856	0	5,724	8,915	0	9,849	6,698	0	7,400
2012	2,276	0	2,295	5,874	0	1,889	0,882	0	5,895	9,032	0	10,079	6,169	0	6,884
2013	2,276	0	2,295	5,970	0	1,950	0,908	0	6,072	9,154	0	10,317	5,684	0	6,406
2014	2,276	0	2,295	6,069	0	2,012	0,936	0	6,254	9,281	0	10,562	5,239	0	5,962
2015	2,276	0	2,296	6,172	0	2,078	0,964	0	6,442	9,412	0	10,815	4,830	0	5,550
2016	2,276	0	2,296	5,601	0	2,116	0,827	0	6,600	8,704	0	11,012	4,060	0	5,137
2017	2,276	0	2,296	5,664	0	2,169	0,848	0	6,765	8,788	0	11,230	3,727	0	4,763
2018	2,276	0	2,296	5,730	0	2,224	0,869	0	6,934	8,875	0	11,454	3,422	0	4,416
2019	2,276	0	2,296	5,798	0	2,280	0,891	0	7,107	8,964	0	11,684	3,142	0	4,095
2020	2,276	0	2,297	5,867	0	2,337	0,913	0	7,285	9,056	0	11,919	2,886	0	3,798
2021	4,324	0	2,297	5,546	0	2,380	0,749	0	7,427	10,618	0	12,104	3,076	0	3,506
2022	4,096	0	2,297	5,598	0	2,431	0,764	0	7,576	10,458	0	12,304	2,754	0	3,240
2023	3,869	0	2,297	5,651	0	2,483	0,779	0	7,727	10,299	0	12,508	2,465	0	2,994
2024	3,641	0	2,297	5,706	0	2,537	0,795	0	7,882	10,142	0	12,716	2,207	0	2,767
2025	3,414	0	2,298	5,762	0	2,592	0,810	0	8,039	9,986	0	12,928	1,976	0	2,558
2026	3,186	0	2,298	5,374	0	2,629	0,827	0	8,200	9,386	0	13,127	1,688	0	2,361
2027	2,959	0	2,298	5,412	0	2,675	0,843	0	8,364	9,214	0	13,337	1,507	0	2,181
2028	2,731	0	2,298	5,452	0	2,723	0,860	0	8,532	9,043	0	13,552	1,344	0	2,014
2029	2,503	0	2,298	5,492	0	2,771	0,877	0	8,702	8,873	0	13,771	1,199	0	1,861
2030	2,276	0	2,299	5,533	0	2,820	0,895	0	8,876	8,704	0	13,995	1,069	0	1,719
Total	62,406	0	52,723	127,413	0	51,739	19,486	0	161,876	209,305	0	266,338	85,24	0	104,16

2.2.5. Mitigation Scenario

In the mitigation scenario outlined three events, the implementation of which will increase the energy efficiency of electricity consumption and reduce CO_2 emissions.

Replace incandescent light bulbs with energy saving lamps

To construct a scenario based data taken of the baseline scenario: the demand for electricity, the number of household subscribers and other consumers of electricity (ministries, agencies, industry, transport, agriculture and others), total number of bulbs used in residential and departmental sectors, the annual electricity consumption incandescent lamps for residential and departmental sectors.

Since the energy-saving lamp, which has a luminous flux, similar to an incandescent lamp, saving 80% energy, annual energy savings from replacing all lamps in the residential and departmental sector was 1,091 billion kWh. [6]

Given the rate of the specific gas consumption per unit of electricity and the coefficient of CO_2 by burning natural gas to assess the annual fuel savings of replacing incandescent light bulbs with energy saving and reduction of CO_2 emissions in the complete replacement of incandescent light bulbs with energy saving.

Given that scenario, mitigation of complete replacement of incandescent lamps is planned for 5 years starting from 2011, estimated annual reduction in CO_2 emissions for 2011-2015.

Calculate IF to replace incandescent lamps produced, based on the fact that for the period 2011-2015 the 20% of incandescent lamps are replaced each year on energy saving, and the rest of incandescent lamps is replaced by the new bulb, because the service life of such lamps, as noted in the baseline scenario, is 1 year. The average lifetime of energy-saving lamps is 10000 hours or 10 years [12]. Therefore, re-IF to replace the energy-saving lamps will be needed from 2021, in the years 2016-2021 provides for the replacement of only 2% of energy saving lamps because of their injuries due to marriage or surges in electric networks. In calculating the IF accepted assumptions: the cost of 1 energy saving lamp - $ 2, cost 1 bulb - 0,2 U.S. dollar.

In the years 2011-2013 provides for the development and adoption of legislation on energy saving. To do this, planned for Financial Flows in the amount of 230 thousand U.S. dollars. At present a project proposal on improvement of legislation in the field of energy conservation to be on the stage of coordination in UNDP and the Government of Turkmenistan, the funds for the project will be highlighted by the British Embassy. Also, the Financial Flows include the cost to develop a standard to limit the import of inefficient light bulbs. The cost of developing a standard adopted by the level of 50 thousand U.S. dollars. Estimated development time standard - for 2011. In addition, the PT reflects the cost of an information campaign to promote the use of energy saving lamps (articles in the media, speech on television, preparation of booklets, etc.). This included the annual cost of $ 10 thousand dollars for the period 2011-2013.

O&M for the residential sector are taken to be 0, so the 35 kWh of electricity per person per month is released free of charge. In the departmental sector O&M determined based on annual consumption of electricity incandescent lamps in the sector and the average tariff for electricity for state-owned enterprises, equal to 1.2 m. or 4,211 • 10-3 USD per 1 kWh In determining the annual consumption of electricity accounted for energy saving energy saving lamps in relation to the baseline scenario.

Replacement of air conditioners for energy-efficient air conditioners

In Turkmenistan, a significant amount of electricity used for air conditioning systems in the hot summer period, and air conditioners are mainly used by middle-class energy efficiency, which are cheaper but consume large amounts of electricity. Therefore, the mitigation scenario is planned in 2011 to use only air conditioners with energy efficiency class A / B, whose power consumption is 20% less than air conditioners

with the middle class, currently in use. Presumably, that all newly acquired air-conditioners in the years 2011-2030, the number of which is calculated in the baseline scenario, will have the energy efficiency of not less than Class B.

In accordance with the norms of depreciation for the full recovery of funds of the national economy of Turkmenistan the life of air conditioners is 25 years. Based on this plan in addition to newly acquired air conditioners Class A / B, an additional 4% annually to replace in-use air conditioners to the new C Class A / B.

Given that the replacement of air conditioners with the middle class for energy efficiency saves 20% of electricity, determined the number of saved electricity for residential and departmental sectors. Based on the specific consumption of natural gas to produce 1 kWh of electricity and CO_2 emission factor for gas combustion data obtained annual saving gas and reducing CO_2 emissions from the replacement of air conditioners for energy efficiency.

Entrepreneurs in the mitigation scenario are equal to the product purchased and the new replacement in the amount of 4% of in-use air conditioners and the market value of energy-efficient air conditioners, equal to $ 500.

Financial Flows include development costs of the standard to limit the import of air conditioners to low performance efficiency. The cost of developing a standard adopted by the level of 50 thousand dollars. Presumably, the standard should be developed for 2011. In addition, the Financial Flows include the cost of an outreach campaign on energy-efficient air conditioners (articles in the media, speech on television, training booklets, etc.). To do this, planned annual cost of $ 10 thousand dollars for the period 2011-2013.

O&M air conditioning estimated as the sum of costs for repairs and to pay for electricity. Repairs of air conditioners made in the amount of 2% of the annual IF. Costs of electricity are based on annual volume of electricity for air conditioning and electricity rates, equal to the residential sector 0,92 m. or 3,228 • 10-3 USD per 1 kWh, and for departmental sector 1,2 m. or 4,211 • 10 - $ 3 for 1 kWh In calculating the annual energy consumption taken into account energy savings in energy efficient air conditioners in comparison with the baseline scenario.

Replacing electric heating with gas boiler

Analysis of power consumption by month showed that in the winter months electricity consumption is much higher than similar rates in the autumn-spring period. This is due to the fact that due to insufficient supply of heat consumers due to wear of thermal networks, a substantial portion of the population, departmental enterprises and organizations use electrical appliances for heating. Moreover, analysis of the volume of electricity in the winter months for the historical period shows that the centralized heat supply is reduced, this leads to an increase in energy consumption for heating. Given that the efficiency of electricity production in power plants Turkmenistan is 30-33%, and the efficiency of gas-fired boiler 95%, the obvious conclusion is that, even without taking into account energy losses in electrical networks energoeffetivnym best way to space heating in residential and in the departmental sectors is heating with gas boiler. [6]

To assess the efficiency of the proposed activities of the calculations for the baseline data used for the consumption of electricity for heating in Turkmenistan [6]. To assess the flow of heat used for heating ratio: 1 MWh = 0.8598 Gcal. The annual increase of heat consumption is defined on the basis of annual growth in electricity consumption for heating the baseline scenario. Also, the calculated total heat boilers in an hour to fully ensure consumers with heat energy for heating during peak hours.

To cover peak heat for heating in Turkmenistan is necessary to construct boiler, taking into account the factor of safety 710 Gcal / hour. According to expert analysis of the construction of such a number of boiler plants within one year is not possible. In addition to heating boilers must be built with total length of 98 km, these Master Plan Strategy for the Development of district heating, UNDP, 2006. Given the possibility

of the work on the construction of boiler rooms and heating mains, the implementation of these works in the years 2011-2020 distributed by year. Thus, during the years 2011-2020 year must be built boiler-hour total capacity of 73 Gcal / hour, with an annual growth of total clock power. [12]

The total length of mains to be built is 98 km. Presumably, the construction will be carried out during 2010-2020 years, in order to minimize the use of electrical appliances for heating. Between the years 2021-2030 will build gas-fired boiler and heating for new construction of homes, businesses and organizations of departmental sector.

Under normal depreciation on the full restoration of funds of the national economy of Turkmenistan lifetime of stationary gas, hot water boilers is 20 years old, but lifetime of heating 25 years.

Given the above defined gas flow rate required for the production of heat by gas boiler. Number of the saving of fuel to generate an identical amount of heat is defined as the difference between the amount of gas needed to generate electricity used for heating, and gas needed to generate heat gas boiler. Applying the factor of CO_2 emissions for combustion of the gas obtained by the volume reduction of CO_2 emissions.

Entrepreneurs in the mitigation scenario derived from the annual value of construction of gas boiler and the cost of heating networks. The cost of boiler is determined based on the number of planned annually for the construction of thermal power and the unit cost of construction of 1 Gcal. The cost of heating networks equals the number of annual planned construction of heating systems and the specific cost of 1 km of heating obtained from the Development Strategy the district heating system, UNDP, 2006.

Financial Flows for the residential sector are taken to be 0, because training for the operation of private boiler is planned. Financial Flows for departmental sector are based on the need for training personnel for repair and maintenance of departmental boiler. Training costs per worker for the gas boiler are estimated at U.S. $ 53, the data obtained from the Development Strategy the district heating system, UNDP, 2006. 12]

O&M for the residential sector until 2020 are defined as the sum of the cost of repairing boilers and remaining in use for heating appliances, as well as the cost of electricity these devices. In 2020, the use of all appliances for heating will be minimized, whereas the gas boiler will provide almost all of the heat demand, so a 2021 O&M for the residential sector, defined as the cost of repair of gas boilers, which are taken at the level of 2% per annum from the IF.

The cost of electricity in the residential sector are estimated based on the annual volume of electricity used by appliances, heating and electricity rates, equal to 0,92 m. or 3,228 • 10-3 USD per 1 kWh When calculating the power consumption into account energy savings from the replacement of electrical heating with gas boiler. The cost of water and gas in the residential sector are equal to 0, because under the law of Turkmenistan's water and gas is released to the population free of charge.

O&M for the departmental sector defined similarly residential sector, but rather the cost of repairs boiler added operating costs, taking into account the cost of water, electricity, wages, repairs boiler and heat networks. Operating costs are estimated as the product of an annual input of heat capacity in departmental and sector specific cost of operational expenses for 1 Gcal equal to 1.87 U.S. dollars according to the Strategy for the Development of district heating, UNDP, 2006 [6,12]. When calculating the cost of electricity passed the average tariff for the electricity sector for departmental equal to 1.2 m. or 4,211 • 10-3 U.S. dollar.

Mitigation Scenario: IF, FF and O&M in terms of customer and type of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps						Replacement of air conditioners for energy-efficient air conditioners						Replacing electric heating with gas boiler					
	Residential			Departmental sector			Residential			Departmental sector			Residential			Departmental sector		
Year	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	OM	IF	FF	O&M	IF	FF	O&M
2008	1,514	0	0	0,583	0	2,202	1,978	0	1,002	0,240	0	0,319	0,498	0	2,653	0,268	0	1,866
2009	1,643	0	0	0,633	0	2,294	4,147	0	1,296	1,302	0	0,422	0,517	0	3,170	0,278	0,000	2,225
2010	1,643	0	0	0,633	0	2,295	5,474	0	1,350	1,644	0	0,428	0,540	0	3,265	0,291	0,000	2,292
2011	4,600	0	0	1,772	0,13	1,927	5,581	0	1,403	1,647	0,06	0,432	2,633	0	2,745	10,098	0,031	2,092
2012	4,271	0	0	1,646	0,09	1,560	5,693	0	1,436	1,650	0,01	0,432	2,288	0	2,227	9,912	0,031	1,894
2013	4,059	0	0	1,564	0,09	1,214	5,809	0	1,471	1,653	0,01	0,433	2,288	0	1,713	9,912	0,031	1,699
2014	3,614	0	0	1,393	0	0,826	5,930	0	1,508	1,657	0	0,433	2,288	0	1,201	9,912	0,031	1,505
2015	3,302	0	0	1,266	0	0,459	6,055	0	1,547	1,660	0	0,433	2,288	0	0,693	9,912	0,031	1,314
2016	0,322	0	0	0,124	0	0,459	5,337	0	1,559	1,664	0	0,433	2,340	0	0,153	9,940	0,031	1,105
2017	0,322	0	0	0,124	0	0,460	5,413	0	1,588	1,667	0	0,433	2,340	0	0,011	9,940	0,031	1,069
2018	0,322	0	0	0,124	0	0,460	5,492	0	1,618	1,671	0	0,434	2,340	0	0,011	9,940	0,031	1,096
2019	0,322	0	0	0,124	0	0,460	5,573	0	1,649	1,674	0	0,434	2,340	0	0,012	9,940	0,031	1,123
2020	0,322	0	0	0,124	0	0,460	5,657	0	1,682	1,678	0	0,434	2,340	0	0,012	9,940	0,031	1,151
2021	1,933	0	0	0,745	0	0,460	5,251	0	1,699	1,681	0	0,435	0,390	0	0,010	5,810	0,005	1,173
2022	1,933	0	0	0,745	0	0,461	5,312	0	1,726	1,685	0	0,435	0,390	0	0,010	5,810	0,005	1,196
2023	1,933	0	0	0,745	0	0,461	5,375	0	1,754	1,689	0	0,436	0,390	0	0,010	5,810	0,005	1,220
2024	1,933	0	0	0,745	0	0,461	5,440	0	1,783	1,692	0	0,436	0,390	0	0,010	5,810	0,005	1,245
2025	1,933	0	0	0,745	0	0,461	5,506	0	1,812	1,696	0	0,437	0,390	0	0,011	5,810	0,005	1,270
2026	1,933	0	0	0,745	0	0,461	5,017	0	1,824	1,700	0	0,437	0,390	0	0,011	4,690	0,005	1,295
2027	1,933	0	0	0,745	0	0,462	5,062	0	1,847	1,704	0	0,438	0,390	0	0,011	4,690	0,005	1,321
2028	1,933	0	0	0,745	0	0,462	5,107	0	1,871	1,708	0	0,439	0,390	0	0,011	4,690	0,005	1,347
2029	1,933	0	0	0,745	0	0,462	5,153	0	1,896	1,711	0	0,439	0,390	0	0,011	4,690	0,005	1,374
2030	1,933	0	0	0,745	0	0,462	5,201	0	1,921	1,715	0	0,440	0,390	0	0,012	4,690	0,005	1,402
Total	45,583	0	0	17,558	0,310	19,688	120,563	0	37,242	36,787	0,080	9,874	28,940	0	17,972	152,783	0,360	33,274

For categories - Residential, Investment Organization - Private owners; Sources I&FF funds - Domestic private funds

For the category - Departmental sector; Investment Organization - Government; Sources I&FF funds - Internal budget

Mitigation scenario: total IF, FF and O&M by types of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps			Replacement of air conditioners for energy-efficient air conditioners			Replacing electric heating with gas boiler			Total costs for all activities			Total discounted costs		
	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M	IF	FF	O&M
2008	2,097	0	2,202	2,218	0	1,321	0,766	0	4,519	5,081	0	8,042	5,081	0	8,042
2009	2,276	0	2,294	5,448	0	1,717	0,795	0	5,395	8,519	0	9,406	7,745	0	8,551
2010	2,276	0	2,295	7,118	0	1,779	0,831	0	5,557	10,225	0	9,630	8,450	0	7,959
2011	6,372	0,13	1,927	7,228	0,06	1,835	12,730	0,031	4,837	26,331	0,221	8,599	19,783	0,166	6,461
2012	5,917	0,09	1,560	7,343	0,01	1,869	12,200	0,031	4,121	25,460	0,131	7,550	17,390	0,089	5,157
2013	5,623	0,09	1,214	7,462	0,01	1,904	12,200	0,031	3,411	25,285	0,131	6,529	15,700	0,081	4,054
2014	5,007	0	0,826	7,587	0	1,941	12,200	0,031	2,706	24,793	0,031	5,474	13,995	0,017	3,090
2015	4,568	0	0,459	7,715	0	1,980	12,200	0,031	2,007	24,483	0,031	4,446	12,564	0,016	2,282
2016	0,446	0	0,459	7,001	0	1,992	12,280	0,031	1,258	19,727	0,031	3,709	9,203	0,014	1,730
2017	0,446	0	0,460	7,081	0	2,022	12,280	0,031	1,080	19,807	0,031	3,561	8,400	0,013	1,510
2018	0,446	0	0,460	7,163	0	2,052	12,280	0,031	1,107	19,889	0,031	3,619	7,668	0,012	1,395
2019	0,446	0	0,460	7,247	0	2,083	12,280	0,031	1,135	19,974	0,031	3,678	7,001	0,011	1,289
2020	0,446	0	0,460	7,334	0	2,116	12,280	0,031	1,163	20,061	0,031	3,739	6,392	0,010	1,191
2021	2,677	0	0,460	6,932	0	2,133	6,200	0,005	1,183	15,809	0,005	3,776	4,579	0,001	1,094
2022	2,677	0	0,461	6,997	0	2,161	6,200	0,005	1,206	15,874	0,005	3,828	4,180	0,001	1,008
2023	2,677	0	0,461	7,064	0	2,189	6,200	0,005	1,230	15,941	0,005	3,881	3,816	0,001	0,929
2024	2,677	0	0,461	7,132	0	2,219	6,200	0,005	1,255	16,009	0,005	3,935	3,484	0,001	0,856
2025	2,677	0	0,461	7,202	0	2,249	6,200	0,005	1,280	16,079	0,005	3,991	3,181	0,001	0,790
2026	2,677	0	0,461	6,717	0	2,262	5,080	0,005	1,306	14,474	0,005	4,029	2,603	0,001	0,725
2027	2,677	0	0,462	6,765	0	2,285	5,080	0,005	1,332	14,523	0,005	4,079	2,375	0,001	0,667
2028	2,677	0	0,462	6,815	0	2,310	5,080	0,005	1,359	14,572	0,005	4,130	2,166	0,001	0,614
2029	2,677	0	0,462	6,865	0	2,335	5,080	0,005	1,386	14,622	0,005	4,183	1,976	0,001	0,565
2030	2,677	0	0,462	6,916	0	2,361	5,080	0,005	1,413	14,674	0,005	4,237	1,803	0,001	0,520
Total	63,141	0,310	19,688	157,350	0,080	157,350	181,722	0,360	51,246	402,213	0,750	118,050	169,53	0,44	60,48

3. Results

3.1 Additional changes to the IF, FF and O&M expenditures, as well as the cost of subsidies

Additional changes represent the difference in all types of investments in the mitigation scenario compared to the baseline scenario.

The total cost of the mitigation scenario is 521.013 million U.S. dollars in the baseline scenario 475.643 million U.S. dollars. Thus, the total additional costs would be required for all types of investments of $ 45.37 million U.S. dollars for the period 2010-2013. Investment costs amount, respectively, 402.213 and 209.305 million U.S. dollars. Thus, the mitigation scenario would require almost 2 times more investment than the baseline scenario. Volume reduction of CO_2 emissions for the period 2010-2030 will amount to 20.89 million tons.

Significant increase in IF in the years 2011-2020 due to the fact that during the years 2011-2015 is planned to complete replacement of incandescent lamps, as well as plans to abandon the use of electrical appliances for heating and to improve the heating of gas-fired boiler in the years 2011-2020. Between the years 2011-2030 will be a planned replacement of air-conditioners air conditioners with high performance efficiency. In the period 2021-2030 years replacement exhaust his term of incandescent lamps and the construction of gas-fired boiler for newly constructed homes and buildings departmental sector will be in much smaller amounts than in the years 2011-2020.

A similar trend is observed for the PT in the years 2011-2020, the additional annual Financial Flows for this period amount to 0.03 million U.S. dollars, and in 2011-2030 years, 0,005 million U.S. dollars.

The main reason for reducing the additional costs for O&M is to save electricity. Despite relatively low tariffs for electricity to let go of local consumers, a significant decrease in O&M in the mitigation scenario, which covers IF in the 148.2 million U.S. dollars. Therefore, the additional investment costs for implementation of planned measures to reduce energy consumption will require about 45 million U.S. dollars.

Additional annual IF, FF and O&M by types of investment organizations and types of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps						Replacement of air conditioners for energy-efficient air conditioners						Replacing electric heating with gas boiler					
	Residential			Departmental sector			Residential			Departmental sector			Residential			Departmental sector		
Year	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	1,095	0	0,002	0,329	0	0,003	0	0	0	0	0	0
2011	2,957	0	0	1,139	0,13	-0,367	1,116	0	0,002	0,329	0,06	0,003	2,076	0	-0,618	9,798	0,031	-0,269
2012	2,628	0	0	1,013	0,09	-0,735	1,139	0	-0,019	0,330	0,01	-0,001	1,715	0	-1,237	9,603	0,031	-0,537
2013	2,416	0	0	0,931	0,09	-1,081	1,162	0	-0,040	0,331	0,01	-0,005	1,698	0	-1,855	9,594	0,031	-0,806
2014	1,971	0	0	0,760	0	-1,469	1,186	0	-0,062	0,331	0	-0,009	1,680	0	-2,474	9,585	0,031	-1,074
2015	1,659	0	0	0,633	0	-1,836	1,211	0	-0,084	0,332	0	-0,013	1,662	0	-3,092	9,575	0,031	-1,343
2016	-1,321	0	0	-0,509	0	-1,836	1,067	0	-0,107	0,333	0	-0,017	1,802	0	-3,725	9,650	0,031	-1,617
2017	-1,321	0	0	-0,509	0	-1,836	1,083	0	-0,126	0,333	0	-0,021	1,789	0	-3,964	9,643	0,031	-1,721
2018	-1,321	0	0	-0,509	0	-1,836	1,098	0	-0,147	0,334	0	-0,026	1,775	0	-4,063	9,636	0,031	-1,764
2019	-1,321	0	0	-0,509	0	-1,836	1,115	0	-0,167	0,335	0	-0,030	1,761	0	-4,164	9,628	0,031	-1,808
2020	-1,321	0	0	-0,509	0	-1,836	1,131	0	-0,188	0,336	0	-0,034	1,746	0	-4,269	9,620	0,031	-1,854
2021	-1,189	0	0	-0,458	0	-1,836	1,050	0	-0,209	0,336	0	-0,038	-0,097	0	-4,354	5,548	0,005	-1,891
2022	-1,024	0	0	-0,395	0	-1,836	1,062	0	-0,228	0,337	0	-0,042	-0,106	0	-4,441	5,543	0,005	-1,928
2023	-0,860	0	0	-0,331	0	-1,836	1,075	0	-0,248	0,338	0	-0,046	-0,116	0	-4,530	5,537	0,005	-1,967
2024	-0,696	0	0	-0,268	0	-1,836	1,088	0	-0,268	0,338	0	-0,050	-0,126	0	-4,620	5,532	0,005	-2,006
2025	-0,531	0	0	-0,205	0	-1,836	1,101	0	-0,288	0,339	0	-0,054	-0,137	0	-4,713	5,526	0,005	-2,046
2026	-0,367	0	0	-0,142	0	-1,836	1,003	0	-0,309	0,340	0	-0,058	-0,147	0	-4,807	4,401	0,005	-2,087
2027	-0,203	0	0	-0,078	0	-1,836	1,012	0	-0,327	0,341	0	-0,062	-0,158	0	-4,903	4,395	0,005	-2,129
2028	-0,039	0	0	-0,015	0	-1,836	1,021	0	-0,346	0,342	0	-0,066	-0,169	0	-5,001	4,389	0,005	-2,172
2029	0,126	0	0	0,048	0	-1,836	1,031	0	-0,365	0,342	0	-0,070	-0,180	0	-5,101	4,383	0,005	-2,215
2030	0,290	0	0	0,112	0	-1,836	1,040	0	-0,384	0,343	0	-0,075	-0,192	0	-5,203	4,377	0,005	-2,259
Total	0,535	0	0	0,200	0,310	-33,034	22,888	0	-3,910	7,049	0,08	-0,713	16,274	0	-77,13	145,96	0,360	-33,49

For categories - Residential, Investment Organization - Private owners; Sources I&FF funds - Domestic private funds
For the category - Departmental sector; Investment Organization - Government; Sources I&FF funds - Internal budget

Additional total annual IF, FF and O&M by types of investment activities for the sector Electricity demand (million USD)

	Replace incandescent light bulbs with energy efficient lamps			Replacement of air conditioners for energy-efficient air conditioners			Replacing electric heating with gas boiler			Total additional costs for all activities			Total discounted additional cost		
	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	1,424	0	0,004	0	0	0	1,424	0	0,004	1,176	0,000	0,003
2011	4,096	0,13	-0,367	1,446	0,06	0,004	11,874	0,031	-0,887	17,416	0,221	-1,250	13,085	0,166	-0,939
2012	3,641	0,09	-0,735	1,469	0,01	-0,021	11,318	0,031	-1,774	16,428	0,131	-2,529	11,220	0,089	-1,728
2013	3,347	0,09	-1,081	1,492	0,01	-0,046	11,292	0,031	-2,661	16,131	0,131	-3,788	10,016	0,081	-2,352
2014	2,731	0	-1,469	1,517	0	-0,071	11,264	0,031	-3,548	15,513	0,031	-5,089	8,756	0,017	-2,872
2015	2,292	0	-1,836	1,543	0	-0,097	11,236	0,031	-4,435	15,071	0,031	-6,369	7,734	0,016	-3,268
2016	-1,830	0	-1,836	1,400	0	-0,124	11,453	0,031	-5,342	11,023	0,031	-7,303	5,142	0,014	-3,407
2017	-1,830	0	-1,836	1,416	0	-0,148	11,432	0,031	-5,685	11,019	0,031	-7,669	4,673	0,013	-3,252
2018	-1,830	0	-1,836	1,433	0	-0,172	11,411	0,031	-5,827	11,014	0,031	-7,835	4,246	0,012	-3,021
2019	-1,830	0	-1,836	1,449	0	-0,196	11,389	0,031	-5,973	11,009	0,031	-8,006	3,859	0,011	-2,806
2020	-1,830	0	-1,836	1,467	0	-0,221	11,367	0,031	-6,122	11,004	0,031	-8,180	3,506	0,010	-2,606
2021	-1,647	0	-1,836	1,386	0	-0,246	5,451	0,005	-6,244	5,191	0,005	-8,327	1,504	0,001	-2,412
2022	-1,419	0	-1,836	1,399	0	-0,270	5,436	0,005	-6,369	5,417	0,005	-8,476	1,426	0,001	-2,232
2023	-1,191	0	-1,836	1,413	0	-0,294	5,421	0,005	-6,497	5,642	0,005	-8,627	1,351	0,001	-2,065
2024	-0,964	0	-1,836	1,426	0	-0,318	5,405	0,005	-6,627	5,868	0,005	-8,781	1,277	0,001	-1,911
2025	-0,736	0	-1,836	1,440	0	-0,342	5,390	0,005	-6,759	6,094	0,005	-8,938	1,206	0,001	-1,768
2026	-0,509	0	-1,836	1,343	0	-0,367	4,253	0,005	-6,894	5,088	0,005	-9,098	0,915	0,001	-1,636
2027	-0,281	0	-1,836	1,353	0	-0,390	4,237	0,005	-7,032	5,309	0,005	-9,258	0,868	0,001	-1,514
2028	-0,054	0	-1,836	1,363	0	-0,413	4,220	0,005	-7,173	5,529	0,005	-9,422	0,822	0,001	-1,401
2029	0,174	0	-1,836	1,373	0	-0,436	4,203	0,005	-7,316	5,750	0,005	-9,589	0,777	0,001	-1,296
2030	0,402	0	-1,836	1,383	0	-0,459	4,185	0,005	-7,463	5,970	0,005	-3,837	0,733	0,001	-1,199
Total	0,735	0,310	-33,034	29,937	0,08	-4,623	162,237	0,360	-110,630	192,908	0,750	-142,367	84,293	0,440	-43,682

3.2 Policy implications

The use of household appliances is steadily increasing, and it is now considered an integral feature of modern life. In this study assessed the potential for energy savings in the use of major appliances: electric light bulbs, air conditioners and elektroobogrevatelnyh devices, which account for more than a quarter of total domestic energy consumption in Turkmenistan (expert estimate based on preliminary studies). It should be noted that these household goods arrive at the consumer market of the country from outside.

Planned average annual consumption in Turkmenistan in the years 2011-2030 is approximately 21 billion kWh Analysis of energy saving by commodity permits the following conclusions:

- The proposed measures to reduce and subsequently for the complete cessation of sales of incandescent light bulbs will save about 1 billion kWh annually, which corresponds to a reduction in domestic consumption of electricity by 4,7%.
- The calculations for the planned shift in sales from inefficient to highly efficient air-conditioners show potential savings of the 77 mln.kVt.ch year, or about 0,4% of total electricity demand.
- Measures to improve the heat from the gas boiler and, consequently, a significant reduction in sales of energy-elektroobogrevatelnyh devices will lead to annual savings of 1.8 billion kwh, or 8.8% of the total projected demand for electricity.

Thus, there is a very significant potential for energy savings only for those appliances in the amount of 13,8-14% of the total electricity demand, leading to a total saving of natural gas - 11,2 billion m^3 and the reduction of CO_2 emissions - almost 21 million tons by 2030.

The total cost of mitigation scenarios for the years 2010-2030 amount to 521,013,000 dollars, the additional costs for building energy-efficient consumption - 45.37 million U.S. dollars. Energy conservation can bring additional revenue to the state budget from the saving of gas exports - at a cost of 2.24 billion U.S. dollars 200 U.S. dollars per 1 m^3, and make profitable energy efficiency measures in the sphere of consumption. Thus, our calculations show a significant net economic benefits - nearly 2.2 billion U.S. dollars from the investment of additional resources - 45.37 million U.S. dollars in the mitigation scenario.

In addition, it should be noted that the decline in demand for electricity consumption in 2030 compared with the baseline scenario at 3.7 billion kWh as a result of energy saving measures will affect the refining industry with plans to introduce new generating capacity in the electricity, etc. e. eliminates the need for the construction of two planned gas-turbine power plants worth $ 240 million, which can also be attributed to the direct benefits of energy conservation.

Major household appliances, including appliances, studied in this paper is imported into Turkmenistan. Therefore, to achieve significant benefits in terms of reducing energy consumption and related greenhouse gas emissions need to improve trade policy in the country that it was aimed at the entry of goods with higher energy efficiency requirements in the consumer market.

There are a number of measures to transform commodity policy. Their choice or a combination thereof is determined by the specific country. In order to improve energy efficiency could be used the whole range of measures: from information and advisory services to financial instruments and mandatory control measures. In Turkmenistan, as the most effective method may be applied a combination of mandatory measures with information support and financial incentives.

Mandatory measures include the introduction of energy efficiency standards to ensure that outdated and inefficient technology is no longer dominated the consumer market, as well as for removal from the market on the worst performance. Standards may include a set of procedures and regulations prescribing minimum requirements for energy performance of goods that are imported into the country. The standards will be most effective if they reinforce direct initiatives to promote the introduction of a qualitatively new products by, for example, an appropriate strategy for public procurement and the requirements of high electrical use in new buildings as housing and departmental sectors.

Financial incentives can be represented by such measures as a partial subsidy of private consumers to purchase high-efficiency appliances, especially for consumers in the lowest strata of the population, reduction in import duties on energy-efficient technologies, one-time tax credits for businesses that purchase goods with energy efficient features, tax reduction value-added energy-efficient products, etc.

Also, in order to reduce the volume of sales of low-efficiency products and attracting high-performance product to the consumer market, are important outreach activities such as training, information campaigns, etc.

The above measures can provide significant results, but subject to availability of an effective institutional mechanism. This requires the establishment of a leading government agency, which will have both the capacity and authority to execute, monitor and control, first of all, mandatory measures.

In the context of this work, the transformation of the consumer market because of good commodity policy will most influence on the change in the structure of sales of light bulbs and air conditioners. As regards heating, in addition to these measures must be approved by the state strategy for improving the supply heat buildings in cities and towns.

In order to finance measures to promote the efficient use of electricity, can serve as a state fund for energy efficiency, replenished with funds from the export of natural gas, savings on energy saving measures.

3.3 Key uncertainties and methodological limitations

In developing this project the experts have identified the following uncertainties for assessing I&FF and O&M:

- Lack of statistics on sales of air conditioners, electrical appliances for heating and incandescent lamps in the historical period. To assess the historical data for the implementation of air conditioners and electrical appliances for heating experts group collected data on their implementation in 2009 for the city of Ashgabat and interpolate these data to other provinces (regions) of Turkmenistan.
- Also, as the uncertainty can be noted a significant increase in the dollar against the national currency in 2008, which affected what cost projection for the years 2009-2030, based on data from 2008 and led to a change in the base year for assessing I&FF and O&M in this study.

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5. Acronyms and Abbreviations

IF	Investment Flows
FF	Financial flows
O&M	Operating expenses
I&FF	Investment and Financial Flows
USA	United States of America
UNDP	United Nations Development Programme United Nations
UN	United Nations
PPC	Public Power Corporation
GES	State Power
TPP	Thermal power central
VL	High-voltage power line
Efficiency	Efficiency
GHG	Greenhouse gases
CO_2	Carbon dioxide (greenhouse gas)
Thousand	thousand
Million	Million
Billion	billion
gr.	Gram
tn.	Ton
km.	Kilometer
m2	square meters
m^3	cubic meter
kWh	A measure of electrical energy (kilowatt-hour)
MW	A measure of electrical power (megawatt-hour of 1 MW = 1000 kWh)
kV	A measure of electric voltage (kV)
Gcal	A measure of heat
AZN	The national currency of Turkmenistan
m.	The national currency of Turkmenistan (100 tenge = 1 manat)
USD	U.S. Dollar
$	Money U.S. dollar sign
%	Percent sign

6. Annexes

Electricity demand in Turkmenistan tys.kVt.ch

Month	January	February	March	April	May	June	July	August	September	October	November	December
2000	830194	780551	804593	650675	654984	651412	728719	713746	643649	737794	840686	917907
2001	917482	811186	828222	701997	686476	708447	759758	740570	687244	776464	856156	981418
2002	979982	865496	877026	739676	694171	726780	809886	804043	713146	778328	858771	1045338
2003	1023896	895417	944041	794581	722719	691770	791303	793916	711499	765839	878381	1022802
2004	990610	853133	910274	792056	735609	760483	821181	819671	741529	851561	914149	1085636
2005	1069043	1007674	943281	857850	803918	829425	926864	859311	794166	859837	979768	1105155
2006	1147997	938637	1018140	879761	866454	916658	973070	976748	828464	861795	986251	1229382
2007	1192962	1053940	1097268	877967	874846	920509	1014576	980874	911578	987699	1070956	1216401
2008	1330930	1141583	1005676	928963	920639	973537	1077081	1070803	916191	954601	1142156	1309700
2009	1331792	1110858	1131295	1012125	901358	963843	1110825	1075422	893499	993411	1158096	1479120

Historical data for the years 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Domestic consumption in billion kwh	8,954	9,455	9,892	10, 036	10,286	11,0967	11,6233	12,2028	12,8128	12,920
CO_2 mln.tn	6,155	6,5	6,8	6,898	7,071	7,627	7,99	8,388	8,807	8,881

Projections for the years 2010-2030

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Domestic consumption in billion kWh	13,69	14,24	14,83	15,42	16,04	16,68	17,35	18,04	18,76	19,51	20,29
CO_2 mln.tn	9, 41	9,788	10,194	10,599	11,026	11,466	11,926	12,4	12,895	13,411	13,95
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Domestic consumption in billion kWh	20,898	21,53	22,17	22,836	23,522	24,227	24,954	25,703	26,474	27,268	
CO_2 mln.tn	14,365	14,799	15,239	15,697	16,169	16,653	17,153	17,668	18,198	18,743	

Measure: Replace incandescent light bulbs with energy efficient lamps

The results of the surveyed sites in the residential sector and departmental

Number of surveyed sites	Power Lamp, W.	Number of incandescent lamps, pieces.							
		Akhal.	Balkans.	Dashoguz	Lebap.	Mary.	Tejen.	Ashgabat.	Total
Departmental sector									
Akhal-60 Balkan-74 Dashoguz-87 Lebap-90 Mary 140 Tejan-36 Ashgabat-11 Total 498	25	0	275	0	0	0	0	0	275
	40	150	1241	1176	984	97	34	17	3699
	60	419	160	816	7659	1138	2	167	10361
	75	226	37	532	270	2321	165	0	3551
	100	1934	1297	2390	7855	7093	1037	111	21717
	150	280	425	297	822	1676	150	15	3665
	200	65	0	0	0	0	0	0	65
The residential sector (population)									
Akhal-60 Balkans 80 Dashoguz-92 Lebap-90 Mary 130 Tejan-76 Ashgabat-13 Total 541	40	46	78	345	88	2	3	33	595
	60	74	85	221	144	5	45	78	652
	75	30	29	162	42	37	42	8	350
	100	257	335	666	243	612	313	64	2490
	150	93	97	81	82	294	54	7	708
	200	19	0	0	0	0	0	0	19

Baseline scenario

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Reducing CO_2 emissions from the replacement bulbs for energy-efficient thousand tons	-	-	-	-	-	-	-	-	-	-	-
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Reducing CO_2 emissions from the replacement bulbs for energy-efficient thousand tons	75,011	150,02	225,03	300,04	375,05	450,06	525,07	600,08	675,08	750,01	

Mitigation Scenario

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Reducing CO_2 emissions from the replacement bulbs for energy-efficient thousand tons	-	150,020	300,040	450,06	600,079	750,099	750,099	750,099	750,099	750,099	750,099
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Reducing CO_2 emissions from the replacement bulbs for energy-efficient thousand tons	750,099	750,099	750,099	750,099	750,099	750,099	750,099	750,099	750,099	750,099	

Measure: Replacement of air conditioners for energy-efficient air conditioners

Mitigation Scenario

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electricity savings from the replacement of air conditioners for energy efficiency. tys.kVt.ch	0	7378	14886	22530	30315	38246	45351	52547	59836	67220	74702
Fuel savings from the replacement of air conditioners for energy efficiency. mln. m^3	0	2,708	5,463	8,269	11,126	14,036	16,644	19,285	21,960	24,670	27,416
Reducing CO_2 emissions from the replacement of air conditioners for energy efficiency. thousand tons	0	5,072	10,233	15,487	20,838	26,290	31,174	36,120	41,131	46,206	51,349
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Electricity savings from the replacement of air conditioners for energy efficiency. tys.kVt.ch	81719	88808	95973	103214	110534	117293	124105	130972	137895	144874	

Fuel savings from the replacement of air conditioners for energy efficiency. mln. m^3	29,991	32,593	35,222	37,880	40,566	43,047	45,546	48,067	50,607	53,169
Reducing CO_2 emissions from the replacement of air conditioners for energy efficiency. thousand tons	56,173	61,046	65,971	70,948	75,980	80,626	85,309	90,029	94,788	99,585

Measure: Replacement of appliances for heating boilers, operating on natural gas

Mitigation Scenario

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
The cost of electricity for elektroobegrev, mln.kVt.ch	-	294,766	589,532	884,298	1179,06	1473,83	1775,29	1889,11	1936,34	1984,75	2034,37
Annual fuel savings from the replacement of electric heating with gas boiler, million m^3	-	27,07	54,1	81,2	108,3	135,3	163,06	173,5	177,9	182,3	186,9
Reducing CO_2 emissions from the replacement of electrical appliances for heating with gas boiler, thousand tons	-	50,7	101,4	152,1	202,8	253,4	305,4	325,04	333,2	341,4	350,06
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
The cost of electricity for elektroobegrev, mln.kVt.ch	2075,05	2116,55	2158,89	2202,06	2246,10	2291,03	2336,85	2383,58	2431,26	2479,88	
Annual fuel savings from the replacement of electric heating with gas boiler, million m^3	190,6	194,4	198,0	202,3	206,3	210,4	214,7	218,9	223,3	227,8	
Reducing CO_2 emissions from the replacement of electrical appliances for heating with gas boiler, thousand tons	356,9	364,1	370,8	378,9	386,3	394,1	402,1	409,9	418,2	426,6	

Saving energy in the mitigation scenario

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total energy savings, mln.kVt.ch	0	520,39	1040,91	1561,56	2082,36	2603,30	2911,87	3032,89	3087,41	3143,20	3200,30
Overall fuel savings, million m^3	0	109,882	219,812	329,792	439,824	549,909	580,211	593,308	600,321	607,479	614,783
Year	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Total energy savings, mln.kVt.ch	3248,01	3296,60	3346,09	3396,51	3447,87	3499,55	3552,19	3605,79	3660,38	3715,99	
Overall fuel savings, million m^3	621,096	627,510	634,029	640,653	647,385	653,992	660,702	667,515	674,435	681,463	

Total CO_2

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Emissions of CO_2 in the baseline scenario, mln.tn	9,41	9,788	10,194	10,599	11,026	11,466	11,926	12,400	12,895	13,411	13,950
Reduction of CO_2 emissions from the use of energy-saving lamps, mln.tn	-	0,15	0,30	0,45	0,60	0,75	0,75	0,75	0,75	0,75	0,75
Reducing CO_2 emissions from the use of air conditioners energeffektivnyh, mln.tn	-	0,005	0,010	0,015	0,021	0,026	0,031	0,036	0,041	0,046	0,051
Reduction of CO_2 emissions from the replacement of electrical appliances for heating with gas boiler, mln.tn	-	0,051	0,101	0,152	0,203	0,253	0,305	0,325	0,333	0,341	0,350
Emissions of CO_2 in the mitigation scenario mln.tn	9,41	9,582	9,783	9,982	10,202	10,436	10,839	11,289	11,771	12,273	12,796

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Emissions of CO_2 in the baseline scenario, mln.tn	14,290	14,649	15,014	15,297	16,129	16,203	16,628	17,068	17,523	17,994
Reduction of CO_2 emissions from the use of energy-saving lamps, mln.tn	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75	0,75
Reducing CO_2 emissions from the use of air conditioners energeffektivnyh, mln.tn	0,056	0,061	0,065	0,070	0,076	0,081	0,085	0,090	0,095	0,100
Reduction of CO_2 emissions from the replacement of electrical appliances for heating with gas boiler, mln.tn	0,357	0,364	0,371	0,379	0,386	0,394	0,402	0,410	0,418	0,426
Emissions of CO_2 in the mitigation scenario mln.tn	13,202	13,624	14,052	14,497	14,956	15,428	15,916	16,418	16,935	17,467