SUPPORT FOR THE DEVELOPMENT OF A NATIONAL ENERGY EFFICIENCY ACTION PLAN FOR BELARUS

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European Bank for Reconstruction and Development

MINISTRY OF FINANCE OF THE SLOVAK REPUBLIC

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LIST OF ABBREVIATIONS

bn.	Billion
Belstat	National Statistical Committee of the Republic of Belarus
BRS	Building Renovation Strategy
BYR	Belarusian ruble (second ruble, from 2000 to 2016)
BYN	Belarusian ruble (third ruble, from 2016 onwards)
CHP	Combined Heat and Power
CO_2eq.	Carbon dioxide equivalent
Department/DEE	Department of Energy Efficiency at the State Committee for Standardisation of the Republic of Belarus
EED	Energy Efficiency Directive (Directive 2012/27/EU)
EnC	Energy Community
EnCS	Energy Community Secretariat
EnMS	Energy Management System
EBRD	European Bank for Reconstruction and Development
ESCO	The Energy Service Company
Gcal	Gigacalorie
Gcal/h	Gigacalorie per hour
GHG	Greenhouse Gases
GDP	Gross Domestic Product
INDC	Intended Nationally Determined Contribution (for the Paris Agreement)
ktce	Kilotonne of coal equivalent
LEAP	Long-range Energy Alternatives Planning System (Energy Model)
mln	Million
MinNREP	Ministry of Natural Resources and Environmental Protection
MBYN	Million BYN
NEEAP	National Energy Efficiency Action Plan
NPP	Nuclear Power Plant
nZEB	Nearly Zero Energy Buildings
RES	Renewable Energy Sources
SECAP	Sustainable Energy and Climate Action Plan
SME	Small and Medium-size Enterprise
SUMP	Sustainable Urban Mobility Plans
TPES	Total Primary Energy Supply
UNDP	United Nations Development Programme
WB	World Bank
WG	Working group

EXECUTIVE SUMMARY

Introduction

This document provides details of the National Energy Efficiency Action Plan (NEEAP) for Belarus. It has been prepared by ENVIROS, s.r.o. who were commissioned by The European Bank for Reconstruction and Development (EBRD) with the support of the Department for Energy Efficiency (DEE) of the State Committee for Standardization of the Republic of Belarus in response to a request by the Administration of the President of Belarus in December 2017. It is a strategic policy document, which sets out the country's final and intermediate national energy savings targets to 2030 and includes concrete measures and actions to meet these targets. The work is financed by the Ministry of Finance of the Slovak Republic.

The development and adoption of a NEEAP is a requirement for EU Member States under the EU Energy Efficiency Directive (EED) as well as for the Energy Community Contracting Parties. The Republic of Belarus applied to become an Observer to the Energy Community in 2016. As such, preparation of a NEEAP is not mandatory for Belarus. Nevertheless, the country decided to prepare its first NEEAP in line with the Energy Community guidelines. The NEEAP will be complementary to other current initiatives in Belarus including the national Sustainability Strategy and will also inform the next submission of the Nationally Determined Contribution (NDC) to the Paris Agreement (due in 2020) and the development of the forthcoming State Energy Savings Programme for 2021 to 2025.

The NEEAP is set out under the following Sections:

- ***Section 1*** outlines the rationale for developing a NEEAP in Belarus and provides an overview of the County's economic and energy situation;
- ***Section 2*** provides an overview of national energy targets and savings achieved to date and compares these to the EU targets;
- ***Section 3*** provides information on planned and prospective measures to achieve the targets.

The analytical work has been supported by the use of the LEAP (Long-range Energy Alternatives Planning) model which was developed by the Stockholm Environment Institute and has already been used in Belarus for its submission on greenhouse gas (GHG) reductions to the Paris Agreement.

Energy Targets

The EED establishes two main targets:

- ***Article 3*** is based on the ***primary*** energy consumption per unit of GDP according to a "Business as Usual" (BAU) scenario;
- ***Article 7*** sets out a target for a reduction in absolute ***final*** energy consumption by 2030. It is the Article 7 target that is mandatory for all EU Member States (though not for Belarus).

As a result Belarus has decided to adopt the Article 7 target even though it is more challenging than the Article 3 target.

The primary energy intensity in Belarus in 2017 was **376.1 kg c.e/MBYN$_{2005}$**, whilst the national target for 2030 according to the Energy Security Concept of Belarus to 2035[1] is **317 kg c.e/MBYN$_{2005}$**, a reduction of 15.7%. The Article 3 target is for a reduction of 32.5 % by 2030 implying an energy intensity of **255 kg c.e/MBYN$_{2005}$**.

[1]http://minenergo.gov.by/wp-content/uploads/

Savings from Existing Programmes

The State Energy Savings Programme for 2016 to 2020 is on target to achieve total energy savings of 5,000 kt c.e. from a wide range of cost-effective measures. Of this total around 4,000 kt c. e. is energy savings derived from the demand side (but expressed in primary energy terms), 875 kt c.e. is from supply side (primary energy) measures with the remaining 125 kt c.e. coming from renewables (which is counted towards the 'energy savings' target in the Programme).

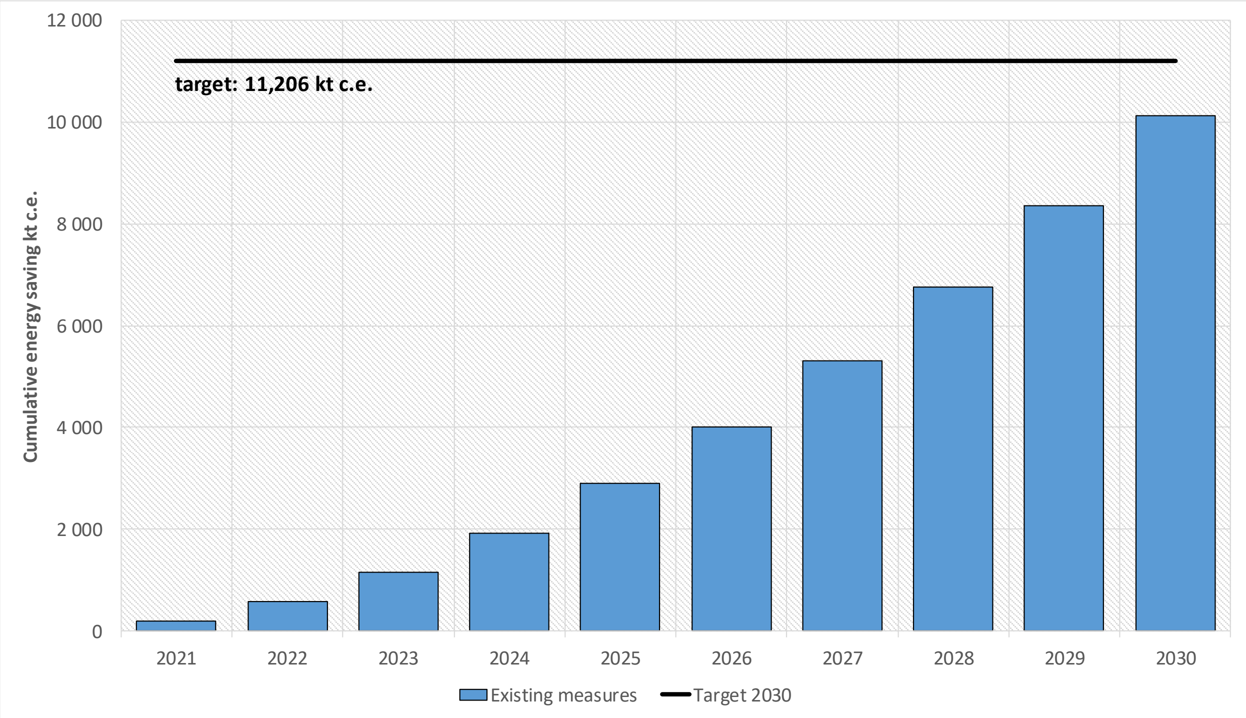
A new State Energy Savings Programme is planned for 2021 to 2025 with a similar range of measures and is expected to save a similar amount, and so should contribute 4,000 kt c.e. of energy savings in demand side consumption and 875 kt c.e. of primary energy (supply side) savings. Hence the total energy saving is expected to be 4,875 kt c.e in the period 2021 – 2025. However, the NEEAP follows the EED Article 7 target which is based on final energy savings only and this figure is expected to be **7,520 kt c.e**. in cumulative terms towards the NEEAP target of **11,206 kt c.e** in the whole period 2021 – 2030.

Even after three State Energy Savings programmes it is likely that there will still be significant savings potential in 2026 to 2030 from implementing similar 'conventional' measures, though the measures to be implemented need to be the subject of a review of the programme prior to its adoption. In this period the total energy savings are estimated at **3,705 kt c.e** made up of 3,300 kt c.e of energy savings in demand side consumption and 405 kt c.e. of primary energy (supply side) savings. This converts to **2,327 kt c.e.** when expressed in terms of final energy.

In addition to the above 'technical' savings it is estimated that improved energy awareness education and training will contribute **50 kt c.e** of new savings, that is **275 kt c.e.** of cumulative demand side energy savings over the 10 year period.

Hence the **total** energy savings in the period 2021 to 2030 from the extension of existing programmes is expected to be **10,122 kt c.e**. against the target of **11,206 kt c.e.** i.e. 90% of the target savings can be achieved by extending the existing programmes. This is illustrated below:

Figure 1 Final energy saving in the period 2021-2030 – existing measures



Planned Measures

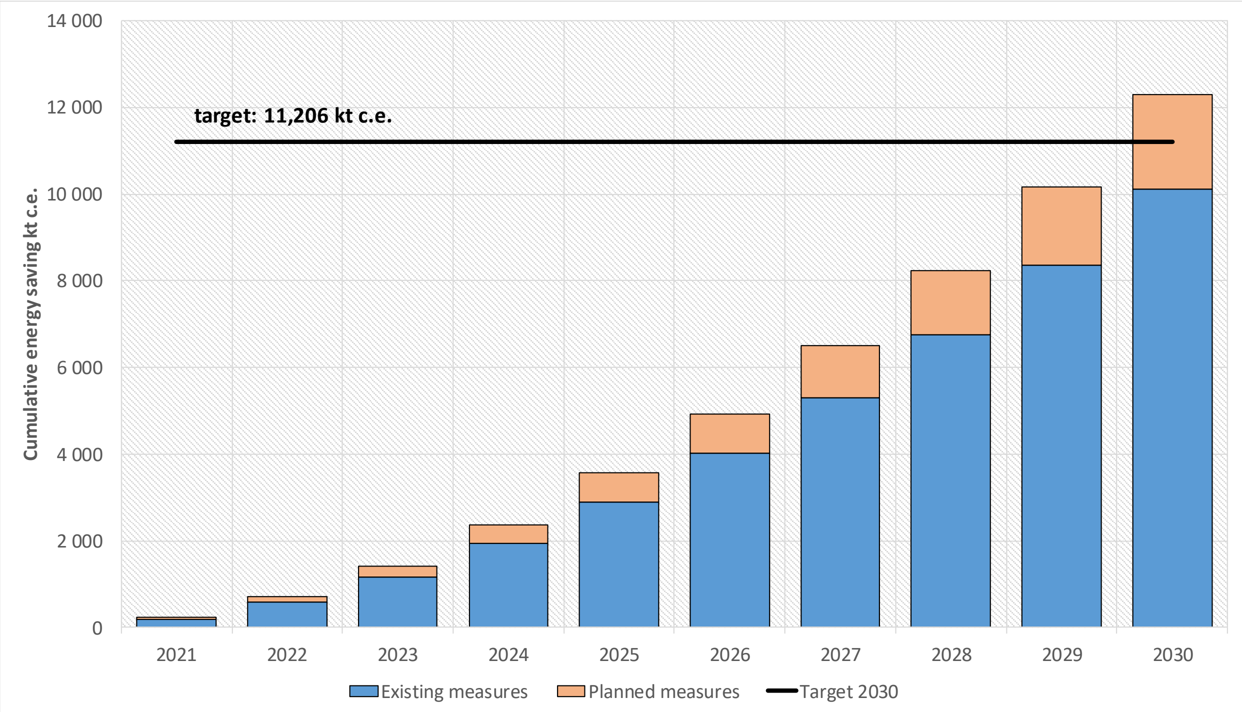
In addition to a continuation of the State Energy Savings Programme, Belarus is intending to implement a range of additional energy saving measures including:

- Removing cross subsidies from households;
- Improving metering and billing in buildings;
- Development of a concept for the introduction of energy services (ESCOs);
- Insulation of buildings in the residential sector via a new “SuperESCO” mechanism;
- Modernisation of street lighting;
- A new Waste to Energy Power Plant in Minsk.

The cumulative primary and final energy savings expected from the new planned measures is **2,168 kt c.e.** in the period 2021 – 2030.

Hence the total anticipated **total** energy savings from the existing (9,897 kt c.e.) and new planned measures (2,168 kt c.e.) is **12,289** kt c.e. or 109.7% of the Article 7 target. This is illustrated below.

Figure 2 Final energy saving in the period 2021-2030 – existing and planned measures



Potential Measures

A number of additional new potential energy saving measures are discussed in Section 3. These include:

Horizontal Measures
- Further Extension of the ESCO Concept

Buildings Measures
- Central database of energy performance in public buildings
- Building Renovation Strategy (BRS)
- Nearly Zero Energy Buildings (nZEB) programme for new construction

Public Authority Measures
- Sustainable Energy and Climate Action Plan (SECAP) in municipalities
- The “Exemplary Role of the State”

Industry Sector Measures

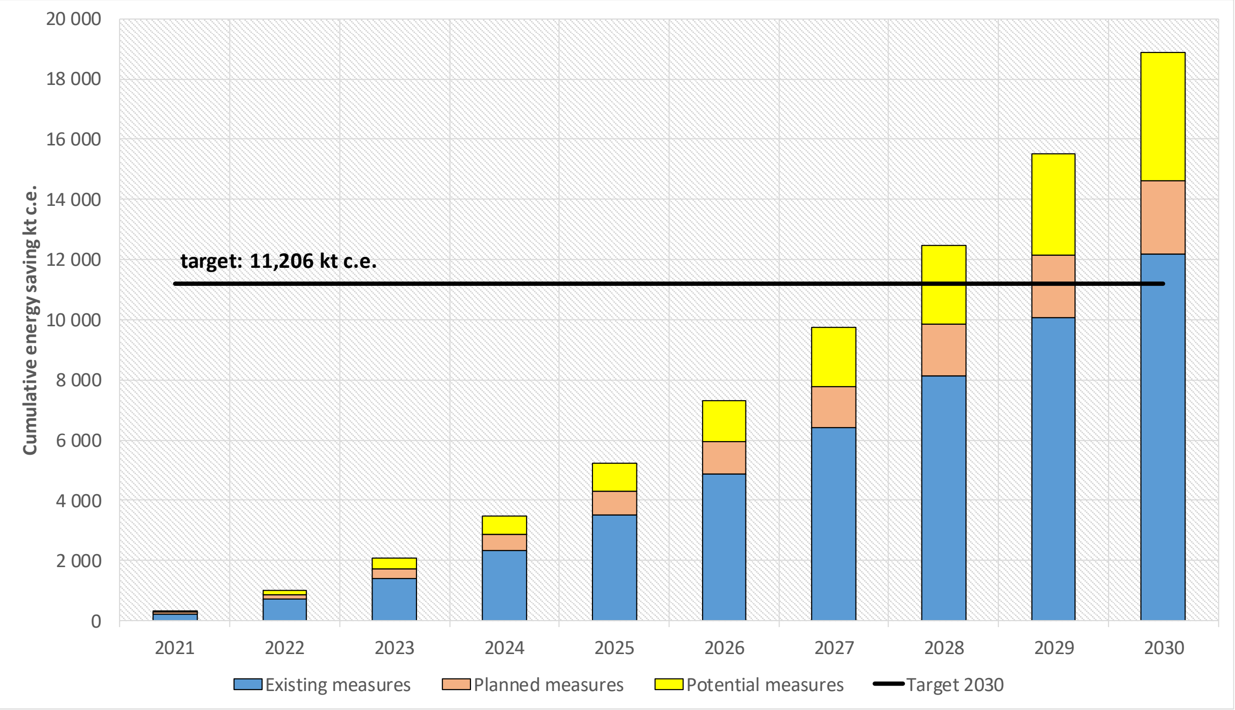
- Energy Management Systems (EnMS)
- "White Certificates" Trades
- Technology and Green Procurements

Transport Sector Measures

- Sustainable Urban Mobility Plans (SUMP)
- Eco-driving for Professional Drivers

The effect on achieving the NEEAP targets from implementing all of the above measures is shown in the diagram below.

Figure 3 Total energy saving in the period 2021-2030 – existing, planned and potential measures

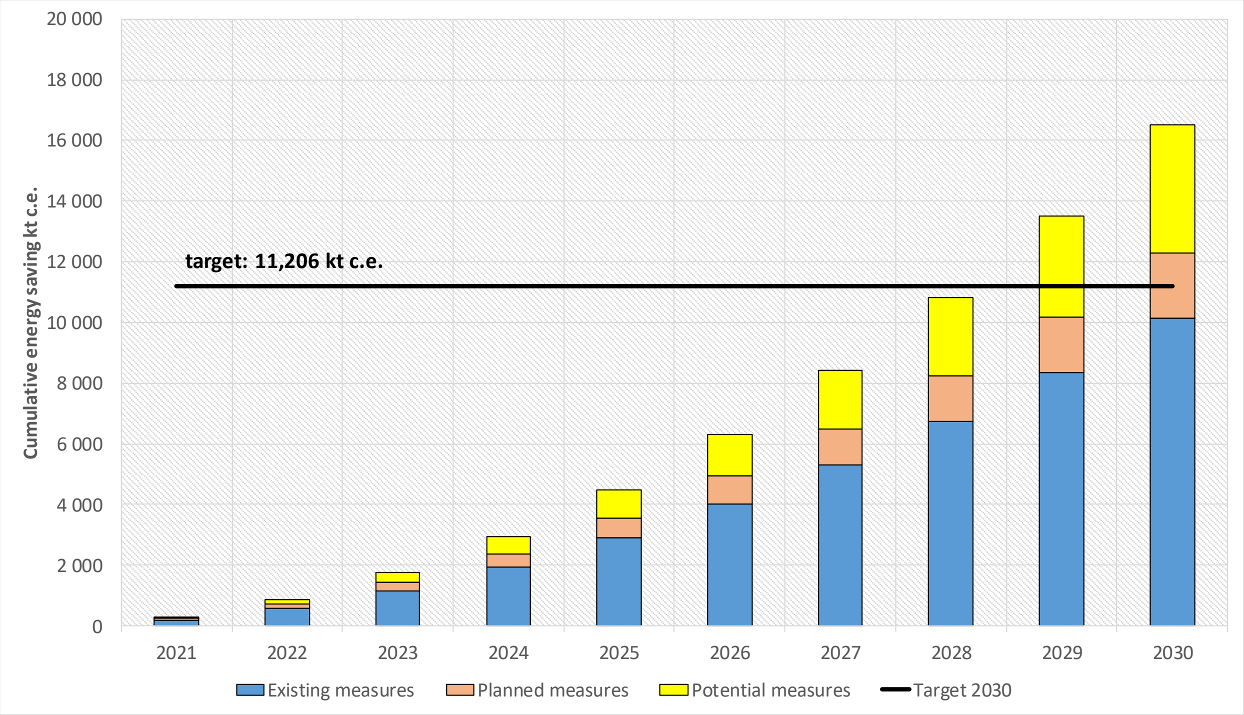


It is evident that the savings from the combined existing, planned and potential measures would take Belarus beyond the target derived from the EU Energy Efficiency Directive. The main reasons for this are:

- The above diagram includes primary energy savings in addition to final energy savings in line with the usual format in Belarus (e.g. in the State Energy Savings Programme) while the EED Article 7 target is for final energy savings only (see the diagram below). The difference is approximately 2,361 kt c.e. or 12.7% of the total savings in 2030.
- Specific energy consumption per unit of GDP is currently significantly higher in Belarus than in the EU so it would be expected that higher savings will be achieved as Belarus implements additional measures, including some of the EU initiatives such as the Building Renovation Strategy and SECAPs.

For comparison the diagram below shows the situation in Belarus if only final (demand side) energy savings are included.

Figure 4 **Final energy saving in the period 2021-2030 – existing, planned and potential measures**

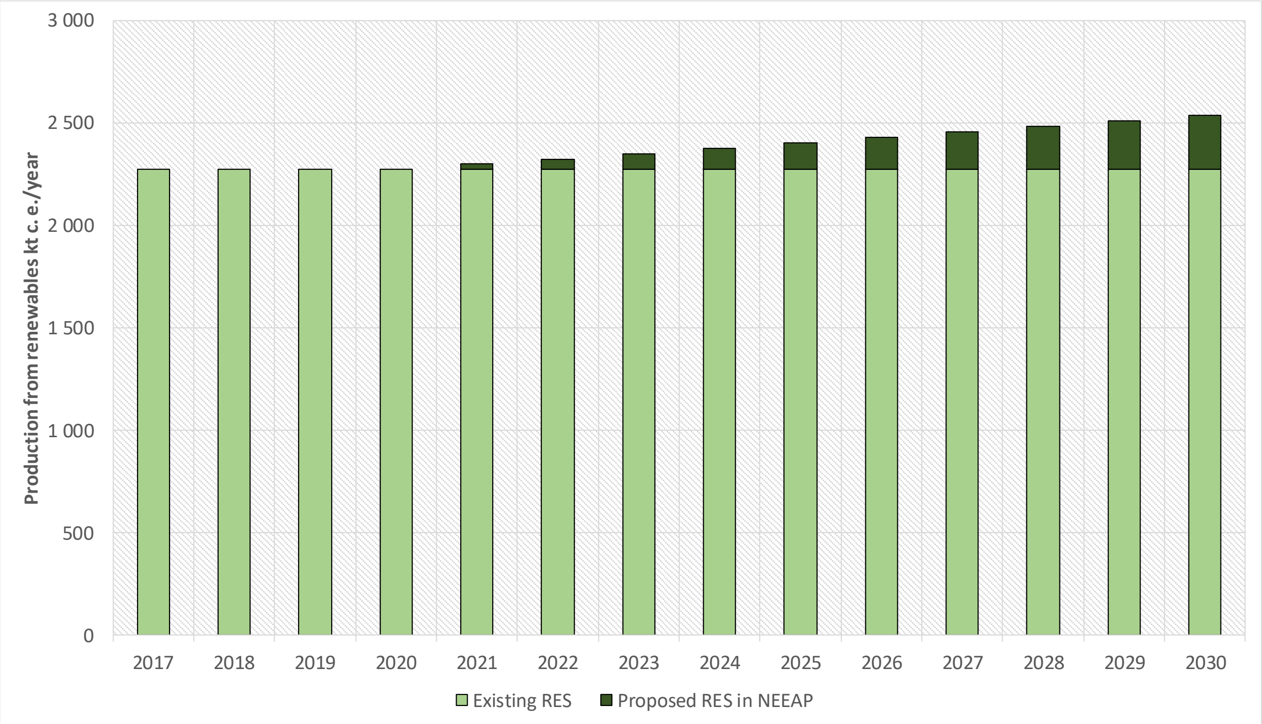


As can be seen the savings on the demand side are well in excess of the NEEAP target.

Renewables

Renewables are not included in the EU NEEAP targets but are part of the normal monitoring mechanisms in Belarus (e.g. in the State Energy Saving Programme) and so have been included in the Belarus NEEAP. The diagram below shows the cumulative effect of increasing renewables from the current (2017) level of 6.2% to 8% by 2030. Belarus has availability of a significant resource base for the development of RES. The level of 8% by 2030 should therefore be achievable even allowing for the presence of the NPP. The new renewables could include both electricity (e.g. wind) and heat (e.g. biomass) and would also cover supply side and on-site renewable energy sources such as biomass in small-scale heating plants, solar photovoltaics and solar thermal on building roofs and electricity generation from landfill gas.

Figure 5 Annual production from renewables in the period 2017-2030 – existing renewables and new proposed in the NEEAP



Clearly the effect on the energy balance of increasing the share of renewables is quite significant, with the cumulative additional production (1,858 kt c.e.) being 9.9% of the cumulative total energy savings from all energy efficiency measures (18,786 kt c.e.).

Roadmap for Energy Savings

The purpose of the NEEAP is to identify policies and measures that have potential to contribute towards the target for 2030 of cumulative energy savings of 11,206 kt c.e. The existing, planned and potential measures are projected to deliver 18,786 kt c.e. of energy savings in 2030 and a consequent reduction in CO_2 emissions of 18,207 kt. Production from additional renewables could contribute the equivalent of 1,858 kt.c.e. of energy supply and a reduction in CO_2 emissions of 3,122 kt.

Cumulative total energy savings, renewables and CO_2 reduction to 2030

Measures	Cumulative energy savings	Cumulative renewables	Cumulative CO_2 reduction
	[kt c.e.]	[kt c.e.]	[kt]
Energy efficiency education and training	275	0	468
State ES Programme 2021-2025	9,165	125	2,373
State ES Programme 2026-2030	2,732	125	1,896
Total existing measures	**12,172**	**250**	**4,737**
Removing cross subsidies from households	398	0	774
Metering and billing	702	0	1,366
Modernisation of street lighting	162	0	590
The ESCO concept in social sector	109	0	193
Insulation of buildings in the residential sector	796	0	2,790
Waste to energy plant in Minsk	281	0	774
Total planned measures	**2,448**	**0**	**6,487**
Building Renovation Strategy[2]	1,021	0	860
Sustainable Urban Mobility Plans (SUMP)	766	0	1,321
The “Exemplary State” process	66	0	240
Extension of the ESCO Concept	448	0	783
Sustainable Energy and Climate Action Plan (SECAP)	676	214	1,593
Energy Management Systems (EnMS)	379	0	656
Technology and Green Procurement	165	0	285
Nearly Zero Energy Buildings (nZEB)	545	185	1,076
White Certificates trades	46	0	76
Eco-driving for Professional Drivers	54	0	93
Total potential measures	**4,166**	**399**	**6,983**
Increase in Renewables	0	1,858	3,122
TOTALS	**18,786**	**2,507**	**21,329**

The Roadmap below contains a framework strategy, including timings for implementation of planned and potential measures.

[2] Central database of energy performance in public buildings is a prerequisite of the Building Renovation Strategy

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Existing measures											
Energy efficiency education and training	2021	●	—	—	—	—	—	—	—	—	▶
State ES Programme 2021-2025	2021	●	—	—	—	●					
State ES Programme 2026-2030	2026						●	—	—	—	●
Planned measures											
Removing cross subsidies from households	2021	●	—	—	—	—	—	—	—	—	▶
Metering and billing	2021	●	—	—	—	—	—	—	—	—	▶
Modernisation of street lighting	2021	●	—	—	—	—	—	—	—	—	▶
The ESCO concept in social sector	2021	●	—	—	—	—	—	—	—	—	▶
Insulation of buildings in the residential sector	2021	●	—	—	—	—	—	—	—	—	▶
Waste to energy plant in Minsk	2022		●	—	—	—	—	—	—	—	▶
Potential measures											
Building Renovation Strategy	2021	●	—	—	—	—	—	—	—	—	▶
Sustainable Urban Mobility Plans (SUMP)	2021	●	—	—	—	—	—	—	—	—	▶
The "Exemplary State" process	2021	●	—	—	—	—	—	—	—	—	▶
Extension of the ESCO Concept	2022		●	—	—	—	—	—	—	—	▶
Sustainable Energy and Climate Action Plan (SECAP)	2021	●	—	—	—	—	—	—	—	—	▶
Energy Management Systems (EnMS)	2022		●	—	—	—	—	—	—	—	▶
Technology and Green Procurement	2023			●	—	—	—	—	—	—	▶
Nearly Zero Energy Buildings (nZEB)	2025					●	—	—	—	—	▶
White Certificates trades	2026						●	—	—	—	▶
Eco-driving for Professional Drivers	2026						●	—	—	—	▶
Increase in Renewables	2021	●	—	—	—	—	—	—	—	—	▶

The starting year of implementation of most planned measures is 2021. Potential new measures will be implemented in a logical sequence to reflect previous activities and required preparatory work. For instance after successful ESCO projects in the social sector, the extension of the ESCO concept could be implemented in 2022. Some measures like Technology and Green Procurement, Nearly Zero Energy Buildings and White Certificates Trades require a longer preparatory phase and therefore implementation is expected after 2023.

Key Action Plan Recommendations

The key Action Plan recommendations to achieve the NEEAP targets are summarised below.

Horizontal measures

1) Take into account the investment efficiency of technical measures in the process of preparation the State Energy Saving Programmes for 2021-2025 and 2026-2030;
2) Expansion of energy services to public buildings and buildings in industry (subject to successful implementation in the social sector);
3) Seek and coordinate further IFI support for horizontal measures.

Buildings

1) Further develop the Building Renovation Strategy (BRS) in order to cover all types of buildings to supplement the Decree on Energy Efficiency in the Residential sector was adopted in September 2019;
2) Set up a national Nearly Zero Energy Building programme and actively promote market uptake of such buildings.

Public sector

1) Establish a regularly updated information system of all public sector buildings containing the total floor area of each building and its energy performance;
2) Cooperate with the Covenant of Mayors East and their signatories in developing SECAPs and monitoring reports;
3) Initiate the "Exemplary State" process. The first step could be including energy efficiency parameters in the public procurement of office equipment.

Industry

1) Improve existing monitoring of energy savings and find new energy savings measures in enterprises within their 5-year programmes by implementation of EnMS;
2) Establish a preparatory phase for the White Certificates complementary to the State Energy Savings Programme;
3) Integrate Technology and Green Procurement in the State Energy Savings Programme.

Transport

1) Cooperate with city representatives in implementation of Sustainable Urban Mobility Plans (SUMPs);
2) Decide whether a training in Eco-driving for Professional Drivers will be obligatory and defined by legislation or the training will be on voluntary basis. Consider economic incentives of training courses.

Investment Costs

The table below shows the investment costs and investment efficiency of the measures in the NEEAP. The basis for calculation of investment costs for existing measures is the investment efficiency in the State Energy Saving Programme described in Table 3-6 in chapter 3.1.2. The basis for planned and potential measures is described in each relevant section of the main document.

Investment Costs and Investment Efficiency

Measures	Cumulative energy savings	Cumulative renewables	Investment Cost	Investment Efficiency
	[kt c.e.]	[kt c.e.]	[mln. BYN]	[mln. BYN/kt c.e.]
Energy efficiency education and training	275	0	4	0.0
State ES Programme 2021-2025	9,165	125	9,282	1.0
State ES Programme 2026-2030	2,732	125	8,023	2.8
Total existing measures	**12,172**	**250**	**17,309**	**1.4**
Removing cross subsidies from households	398	0	214	0.5
Metering and billing	702	0	150	0.2
Modernisation of street lighting	162	0	562	3.5
The ESCO concept in social sector	109	0	360	3.3
Insulation of buildings in the residential sector	796	0	2 058	2.6
Waste to energy plant in Minsk	281	0	660	2.3
Total planned measures	**2,448**	**0**	**4,004**	**1.6**
Building Renovation Strategy	1 021	0	2,639	2.6
Sustainable Urban Mobility Plans (SUMP)	766	0	10,000	13.1
The “Exemplary State” process	66	0	0	0.0
Extension of the ESCO Concept	448	0	1,479	3.3
Sustainable Energy and Climate Action Plan (SECAP)	676	214	976	1.1
Energy Management Systems (EnMS)	379	0	819	2.2
Technology and Green Procurement	165	0	97	0.6
Nearly Zero Energy Buildings (nZEB)	545	185	2,518	3.5
White Certificates trades	46	0	110	2.4
Eco-driving for Professional Drivers	54	0	14	0.3
Total potential measures	**4,166**	**399**	**18,652**	**4.1**
Increase in Renewables	0	1,858	3,131	1.7
TOTALS	**18,786**	**2,507**	**43,096**	**2.0**

At first sight the total investment cost of 43,096 mln. BYN looks very high. However, on closer examination it is apparent that:

- 17,309 mln. BYN (40%) is attributable to the State Energy Saving Programmes for 2021-2025 and 2026-2030 which would be anticipated without the NEEAP;
- 4,004 mln. BYN (9%) are committed to already planned measures;
- 10,000 mln. BYN (23%) is for Sustainable Urban Mobility Plans (SUMPs) which will be implemented primarily for reasons other than energy saving (such as improving air quality and reducing congestion in cities) and include infrastructure investments that do not lead directly to energy savings;
- 3,131 mln. BYN (10%) is for renewables incentives which are separate from the energy saving measures and will be subject to a different decision making process.

This leaves an additional **8,652 mln. BYN** (20%) to be found over 10 years to finance the potential energy saving measures other than the SUMPs.

Apart from the SUMPs the investment efficiency of all of the measures is in the same range as in the current State Energy Saving Programme.

Sources of Finance

Potential Sources of Finance for all of the measures are shown in the following table.

Potential Sources of Finance

Measures	Potential Sources of Finance				
	Organisation Own Funds/Loans	State Budget	Local Budgets	Private Investor (inc. ESCOs)	International Financial Institutions
Existing measures					
Energy efficiency education and training	X	X			
State ES Programme 2021-2025	X	X	X		X
State ES Programme 2026-2030	X	X	X		X
Planned measures					
Removing cross subsidies from households		X			
Metering and billing	X	X			
Modernisation of street lighting			X	X	X
The ESCO concept in the social sector		X		X	X
Insulation of buildings in the residential sector	X	X	X	X	X
Waste to energy plant in Minsk		X	X		
Potential measures					
Building Renovation Strategy	X	X	X	X	X
Sustainable Urban Mobility Plans (SUMP)	X		X		X
The “Exemplary State” process		X	X		
Extension of the ESCO Concept		X	X	X	X
Sustainable Energy and Climate Action Plan (SECAP)	X		X	X	X
Energy Management Systems (EnMS)	X			X	
Technology and Green Procurement	X	X	X		
Nearly Zero Energy Buildings (nZEB)	X	X	X	X	X
White Certificates Trades	X	X			
Eco-driving for Professional Drivers	X	X			
Increase in Renewables	X	X	X	X	X

As is the case with the current State Energy Saving Programme, organisations' own funds (or loans that they arrange) can be expected to continue to be the predominant source of finance for most of the measures.

Contributions from the State Budget will be required in the majority of measures but will be particularly important in removing cross-subsidies for households (supporting low income households), the Buildings Renovation Strategy (including insulation of residential buildings), nearly Zero Energy Buildings and Financial Incentives for Renewables.

Local Budgets will also contribute to these measures (apart from removing subsidies) but will also be particularly important in the implementation of SUMPs and SECAPs, both of which are developed at the City level.

There is likely to be increased investments from private investors, especially as the ESCO concept becomes more established. ESCOs can be expected to make a significant contribution, especially in the buildings measures and in street lighting, provided that the regulatory framework in Belarus is fully developed. Private investment in renewables is also likely if the business case is sufficiently robust.

Finally the IFIs and other international organisations can be expected to play an increasing role in energy projects in Belarus. EBRD, EIB, the World Bank, NEFCO and UNDP are already supporting a number of initiatives and are ready to invest more as the energy saving and renewables programmes develop. Discussions are ongoing with the Belarus government on future financing possibilities.

Although the investment cost for the NEEAP is high, the fact that it is spread over 10 years and across a number of potential financing sources means that the measures in the NEEAP should be affordable and that the Plan is practical and implementable. It is also worth bearing in mind that there are significant further benefits arising from the NEEAP including:

- Substantial CO_2 savings;
- Reduction in imported energy and hence enhanced energy security;
- Increased competitiveness of industry;
- Increased private sector investments;
- Job creation in the energy efficiency and renewables sectors.

All of these are powerful additional arguments for adopting the NEEAP in Belarus.

1 INTRODUCTION

1.1 Rationale for developing a NEEAP in Belarus

The National Energy Efficiency Action Plan, hereinafter referred to as the NEEAP, has been prepared by ENVIROS s.r.o. who were commissioned by The European Bank for Reconstruction and Development (EBRD) with the support of the Department for Energy Efficiency of the State Committee for Standardization of the Republic of Belarus in response to a request by the Administration of the President of Belarus in December 2017. It is a strategic policy document, which sets out the country's overall and intermediate national energy savings targets to 2030 and includes concrete measures and actions to meet these targets.

The NEEAP allows Belarus to identify the necessary steps to address its energy intensity of GDP through a reduction of primary and final energy consumption. Besides several horizontal measures applied across different sectors, this NEEAP includes recent and ongoing energy efficiency efforts and progress in buildings, public bodies, industry, transport, district heating and energy transformation, transmission, distribution and demand response sectors. Information is also provided on significant primary and final energy-saving measures, together with the associated CO_2 savings. This NEEAP also brings some new measures across all of the main sectors (industry, buildings, transport, and energy supply) as well as several 'horizontal' measures that affect all sectors.

The development and adoption of a NEEAP is a requirement for EU Member States under the EU energy efficiency acquis as well as for the Energy Community Contracting Parties. The Republic of Belarus applied to become an Observer to the Energy Community in 2016. As such, the country may participate in the meetings of the Community but is not obligated to implement its legislation or participate in decision-making or its Single Energy Market. Nevertheless, the country decided to prepare its first NEEAP in line with the importance assigned to energy efficiency and the broader issue of energy security, and as a preparation to meet its commitments under the Energy Community Treaty, should it become a Contracting Party in the future.

1.2 Overview of Belarusian Economic and Energy Situation

The Republic of Belarus applied to become an Observer to the Energy Community in 2016. As such, the country may participate in the meetings of the Community but is not obligated to implement its legislation or participate in decision-making or its Single Energy Market. Contracting Parties of the Energy Community need to develop National Energy Efficiency Action Plans, but as neither a Contracting Party nor an Observer to the Energy Community, Belarus is not obligated to develop a NEEAP. Nevertheless, the country decided to prepare its first NEEAP in line with the importance assigned to energy efficiency and the broader issue of energy security, and as a preparation to meet its commitments under the Energy Community Treaty, should it become a Contracting Party in the future.

The Belarusian energy sector has a number of national characteristics which have shaped the development of this first NEEAP as well as their impact on primary energy demand and final energy end-use.

Macroeconomic factors – Investments in Belarus, including investments in sustainable energy, largely depend on the public sector, with very little private finance. The energy sector is still largely vertically integrated, with State-owned companies, and BelEnergo in particular, central to the expansion and operation of the energy system. Moreover, historically the country has developed a complex system of energy (cross-)subsidies. These macroeconomic factors contribute to the low penetration of private and foreign actors in the development of the Belarusian energy market.

Impact of the economic crisis – After two years of recession in 2015 and 2016, the Belarusian economy resumed growth in 2017, increasing by 2.5%. Since 2016, the government worked towards eliminating price regulation, reducing energy tariff cross-subsidies to households, reforming public finances and taxation, and improving the business environment. The economic crisis did have an impact on the energy intensity of GDP of the country as GDP growth stagnated, and as such the energy intensity of GDP target had to be recalculated using the adjusted (slower) GDP growth than expected.

In addition, this target was affected by decreasing oil refining volumes from Russia due to increased oil prices for Belarus. Oil refining had a significant impact on the total primary energy supply (TPES), and as such on the calculation of the energy intensity of GDP target.

Changes in energy consumption – According to the latest official statistics provided by Belstat for 2017, final energy consumption in Belarus has increased much more modestly than the economy, reaching 25,992 kt c.e (761.8 PJ) in 2017, an increase of 14.4% over the 2000 level. In 2017, the largest final energy consumer in the country was the industrial sector, accounting for 32.4%, a slight decrease from a 34.5% share in 2010. The second largest consumer was households, which consumed over 28.1% of the total final consumption, a relatively constant share compared to 2010 (28%). The transport sector consumed 22.2% of total final consumption, a slight increase from 2010 (19.8%), and finally the service sector consumed 9.9%, a slight decrease from 2010 (10.1%). Regarding total electricity consumption, it slightly increased between 2000 and 2017, from around 33.3 TWh in 2000 to 37.1 TWh in 2017, due to higher final consumption in industry and services. Total heat consumption slightly decreased, from around 69.1 mln. Gcal (289.3 PJ) in 2000 to around 60 Gcal (251.2 PJ) in 2017, approximately two thirds being consumed by industry and services, and one third by the residential sector. Total final energy consumption of natural gas decreased by 10% between 2010 and 2017 due to implementation of energy efficiency measures.

Changes in energy imports and exports – Belarus has a high energy import dependency (around 85%), primarily from oil and natural gas imports from Russia, as it does not yet have sufficient domestic primary energy sources. As a result, ensuring energy security through improving the fuel and energy mix in parallel with increased energy efficiency (EE), renewable energy sources (RES) and promotion of other environmentally friendly clean technologies has been a priority agenda for Belarus for several decades.

Structural changes – Restructuring the energy sector has been identified as one of the main areas for improvement in the energy sector. This relates to the current strong vertical integration of the Belarusian energy sector with a dominant participation of State-owned companies and the major role played by the government in regulating, planning and monitoring. Unbundling of the electricity supply chains and the gradual introduction of wholesale electricity markets are necessary, as well as the establishment of a national regulator to allow for greater participation of independent power producers and decentralised generation. Third-party electricity grid connection in Belarus for renewables has been allowed since 2013, following revisions to the Law on Electricity. Such a restructuring and the increased role of private actors and foreign investors is also relevant to developing local and renewable energy sources, improving energy efficiency and in general fostering the substantial investment in the whole energy value chain which the energy sector requires.

Developments in other sectors – Belarus is constructing a nuclear power plant (NPP) in Ostrovets with an output of 2,400 MW as one of the main measures to ensure a significant improvement in the efficiency of electricity production and reliability of the electricity supply. The NPP is expected to commence operation in mid-2020 (1st unit) and at the end of 2021 (2nd unit). A roadmap for the integration of the planned NPP into the Belarusian energy system is provided in the Comprehensive Plan for the Development of the Electric Power Industry until 2025 from 2016.

Regarding renewable energy sources (RES), the supply of renewable energy in Belarus amounted to 2,271 kt c.e (66.6 PJ) in 2017, or 6.2% of the total primary energy supply, an increase from 5.4% in 2010. Wood, biofuels, biogas and renewable waste provide 96.8% of this renewable energy supply, with hydro (2.2%) and geothermal, solar and wind (1%) accounting for the rest. The total final consumption in 2017 directly used 1,049 kt c.e (30.7 PJ) of renewable energy (including solid biofuels - 956 kt c.e (28.0 PJ), and electricity from renewable energy sources 92 kt c.e (2.7 PJ)), or 4% of final consumption. There remains a large untapped[3] RES potential in Belarus (biomass energy is the most technically available together with wind energy and solar energy) and renewables could play an important role in meeting Belarusian strategic needs to decrease energy import dependency. This needs to come primarily through developing a strong supportive regulatory framework for RES in Belarus, which is currently not sufficient to steer investment into this sector.

Financial instruments for private actors – In Belarus, there is currently no specific government fund dedicated to providing financial incentives to the energy efficiency programmes, while the Energy Efficiency Department monitors the level of investment in energy efficient technologies.

[3] https://www.enercee.net/fileadmin/enercee/images-2016/Belarus/Investment_Guide_Belarus.pdf

Moreover, financial instruments for energy service companies (ESCOs) do not yet exist in Belarus and awareness of the concept and of the benefits is low (only one example of an ESCO operating in the Belarusian market was identified to date). Such instruments are needed to facilitate the financing of energy efficiency projects by private actors and to increase their participation in the energy sector.

International commitments – In 2016, Belarus signed the Paris Agreement and submitted its first Intended Nationally Determined Contribution (INDC), strengthening its commitment to climate change mitigation. The country is also involved in the Energy Charter Treaty and applied to become an Observer to the Energy Community Treaty in October 2016. It cooperates with leading international organisations on climate change and energy efficiency topics highlights the importance sustainable energy has in Belarus. This also has an impact on development of the current NEEAP (this document) and the sustainable energy regulatory framework in Belarus in general.

These national characteristics determine the central energy policy objectives of Belarus, which are:

- to increase energy self-sufficiency through local and renewable energy sources;
- to promote energy efficiency and thus reduce the energy intensity of the economy;
- to contain greenhouse gases emissions following international commitments;
- to restructure and modernize the energy sector, eliminating (cross-)subsidies, and
- to increase the use of electricity in the energy system following the commissioning of the nuclear power plant.

Over time the country has improved the overarching regulatory framework for the energy sector, especially in the last few years. This framework is based on a hierarchy of high-level documents setting a long-term strategy, together with policy documents providing detail for the medium- and short-term, establishing measures to implement the strategies and achieve targets, often specific to certain sectors or technologies.

There are several key legal documents regulating the energy sector in Belarus and providing the wider policy context for this NEEAP.

Currently, the main energy policy document is the **Energy Security Concept 2035**[4] from 2015 defining the essence of the activities to ensure the energy security of the Republic of Belarus and the reliability of energy supply to the sectors of the economy and population. It sets the key quantitative energy targets up to 2035 (in 5-year periods), on for example the energy intensity of GDP, the share of RES or the share of participation of domestic fuels and energy resources in the domestic energy consumption. Energy security is the main policy priority for Belarus as the country is heavily dependent on the import of natural gas from Russia, as mentioned above.

Another important energy policy document is the **Comprehensive Plan for the Development of the Electric Power Industry until 2025**[5] from 2016, which provides a roadmap for the integration of the planned NPP into the Belarusian energy system, and details a timeframe for the strategies outlined in the Energy Security Concept. The Comprehensive Plan provides for a long list of concrete implementation measures in the electric power system in Belarus, including increased electrification of the energy sector by providing incentives for the deployment of electric vehicles and of electric boilers.

With regard to specific thematic areas, the key policy document in the field of energy efficiency (EE) is the **State Programme on Energy Saving for the Period 2016-2020**[6]. This is a key policy document on EE establishing concrete measures and targets to achieve energy savings in Belarus, with also a (less important component) on the development of renewable and local energy resources. The Programme includes a referral to the budget available in Belarus for such measures, as well as a process to monitor these.

A Resolution of the Council of Ministers of the Republic of Belarus in August 2018 made additions and changes to the Resolution of March 2016 **"On approval of a comprehensive plan for the development of the electricity sector by 2025, taking into account the commissioning of the Belarusian Nuclear Power Plant".** In particular, a sectorial complex of measures to increase electricity consumption until 2025 was approved.

4 http://minenergo.gov.by/wp-content/uploads/
5 http://minenergo.gov.by/wp-content/uploads/
6 http://energoeffekt.gov.by/downloads/programs/program_psm248_2016_2020.docx

These include projects to update specific industrial processes in the main sectors (metals, engineering, chemicals / petrochemicals), the installation of electric boilers in buildings for heating and hot water, the promotion of electric vehicles and charging network, and electrification of several railway lines.

The inter-industry complex of measures is formed from investment projects planned for implementation by 2025 by the Ministry of Industry, Ministry of Transport, Ministry of Construction and Architecture and Ministry of Housing and Communal Services.

As a result of the implementation of all measures of the inter-industry complex of measures, the increase in electrical energy consumption in 2026 is expected to be 2.7 billion kWh per year, which will improve the technical (grid 'balancing') and economic (cost optimisation) performance of the Belarusian energy system in the context of the commissioning of the Belarusian nuclear power plant.

The **Law on Renewable Energy Sources**[7] from 2010 and **the Presidential Decree on the Use of Renewable Energy**[8] dated 24 September 2019 "On Renewable Energy Sources" are the key pieces of legislation in the field of renewable energy. Increasing the share of RES in domestic energy production has been has been labelled indicated as a one of the priorities. The Law on RES itself provides for the definition and implementation of a unified state RES policy, covering solar, wind, geothermal, hydro, fuel wood and other types of biomass, biogas, and other renewable energy sources. This Law has been amended by the Presidential Decree on the Use of Renewable Energy, creating target quotas for grid-connected RES projects.

With regard to climate change mitigation and adaptation, Belarus submitted its first **Intended Nationally Determined Contribution**[9] report in 2016. This INDC sets the Belarusian commitment on GHG emission reduction by 2030. The INDC specifies that further policies, programmes and measures to fulfil the commitments for the period 2021-2030 would be elaborated. Furthermore, the government has used the energy and climate mitigation integrated modelling tool LEAP in order to break-down the overarching emission reduction target into specific energy, industry, transport and waste indicators. This model has also been used in the preparation of this NEEAP.

7 http://minenergo.gov.by/wp-content/uploads/Zakon-ot-27.12.2010-204-Z-O-vozobn.-istochnikah-jenergii.docx
8 http://pravo.by/document/?guid=12551&p0=P31900357&p1=1&p5=0
9 http://minpriroda.gov.by/uploads/files/Belarus-INDC-Eng.pdf

2 OVERVIEW OF NATIONAL ENERGY TARGETS AND ACHIEVED SAVINGS

2.1 National Energy Targets for 2030

Within the EU, national energy efficiency targets are set in accordance with Energy Efficiency Directive (EED) 2018/2002/EU, which establishes a common framework of measures to promote energy efficiency within the European Union. Article 3 of the EED contributes towards achieving the target of improving energy intensity per unit of GDP by at least 32.5 % by 2030. The 32.5 % target is a reduction of primary and final energy consumption compared to the PRIMES[10] baseline (Business as Usual - BAU) scenario finalised in 2007. The scenario simulates trends in energy consumption of 27 EU Member States.

EU Member States should achieve the 32.5 % target in both primary and final energy reduction. It is more difficult to achieve the 32.5 % reduction of final energy rather than primary energy, therefore the target for final energy is more important.

Because a PRIMES baseline scenario is not available for Belarus, the 32.5 % target has been calculated according to the Belarusian BAU scenario. The indicative target is expressed in primary energy intensity to be comparable with the national target 317 kg ce/MBYN$_{2005}$ in 2030 and is also reflected in final energy intensity.

Primary energy intensity

The primary energy intensity of gross domestic product (total primary energy supply/gross domestic product) in the BAU scenario in 2030 is assumed to be at the current level of 376 kg ce/MBYN$_{2005.}$

The indicative target for Belarus is calculated to be 254 kg ce/MBYN$_{2005.}$ i.e. a 32.5% reduction.

Table 2-1 Primary energy intensity of gross domestic product - national target and indicative EU target according to Article 3

	Unit	2017	2020	2025	2030	2035
Energy intensity of gross domestic product – BAU scenario[11]	kg c e/MBYN$_{2005}$	376	376	376	376	376
Energy intensity of gross domestic product – national target	kg ce/MBYN$_{2005}$	376	370	353	317	268
Energy intensity of gross domestic product – indicative target according to EU Directive (Article 3)	kg ce/MBYN$_{2005}$	376	376	316	254	

This implies that a further 16.4% saving over the current national target for 2030 is required to meet the Article 3 target (though this is not mandatory for Belarus as neither a Contracting Party nor an Observer to the Energy Community).

Final energy intensity

Final energy intensity for 2017 was calculated using Belstat data.

- Final energy consumption 25,992 kt. c.e. in the year 2017
- GDP 97,990 bn. BYN$_{2005}$

Final energy intensity in 2017 was therefore 272 kg ce/MBYN$_{2005.}$

The indicative target for Belarus according to the Article 3 target is therefore 183 kg ce/MBYN$_{2005.}$

[10] The PRIMES (Price-Induced Market Equilibrium System) energy system model has been developed by the Energy-Economy-Environment Modelling Laboratory at National Technical University of Athens in the context of a series of research programmes co-financed by the European Commission.
[11] The EU methodology assumes a constant BAU value from the base year.

Table 2-2 Final energy intensity of gross domestic product – indicative target according to Article 3 target

	Unit	2017	2020	2025	2030
Final energy intensity of gross domestic product – BAU scenario	kg ce /MBYN2005	272	272	272	272
Final energy intensity of gross domestic product – indicative target according to EU target	kg ce /MBYN2005	272	272	228	183

2.2 Impacts of the targets

According to Belstat the final energy consumption in 2017 was 25,992 kt c.e. and the primary energy consumption was 36,121 kt c.e. A reduction of 32.5% therefore implies savings of 8,447 kt c.e. in final energy consumption and 11,739 kt c.e. in primary energy consumption, leading to a final energy consumption of 17,545 kt c.e. and a primary energy consumption of 24,382 kt c.e. by 2030 according the Article 3. However, Article 7 of the EED goes on to specify absolute savings in final energy consumption which are higher than the above figures as discussed in Section 3.1.1. It is the Article 7 targets that are mandatory for all Member States (though not for Belarus).

For Belarus the primary energy savings achieved by all measures have also been calculated, initially using the ratio of final energy to primary energy for 2017 (70.5%). Savings measures in energy supply will increase the primary energy savings but not the final energy savings figure and so will change the 2017 ratio.

These are challenging targets that cannot be met by the current and planned measures alone. Achieving the targets can only come about from implementing additional measures as discussed in the following section of this document.

2.3 Additional energy efficiency and renewable energy targets

In addition to the national energy efficiency targets mentioned above, Belarus has set a short-term sectoral energy efficiency target for industry. The National Programme on Energy Savings for 2016-2020[12] stipulates a reduction of 2% in energy consumption by the industry sector from 2015 to 2020. This target appears to be very low compared with the potential for savings and implies that further measures could be adopted in this sector.

Belarus has also set a national renewable energy sources (RES) target[13] of an 8% share of RES in total primary energy consumption by 2030, according to the Energy Security Concept 2035.

Table 2-3 National RES target

Target	Unit	2017	2020	2025	2030	2035
Renewable energy production to total primary energy consumption ratio	%	6.2	6	7	8	9

This level of renewables penetration is low in comparison to other countries in the region (and the EU norm). For example the RES targets for 2030 are 17% in Ukraine and 21% in Poland, whilst the EU target is 32%. This suggests that additional support for renewables would result in greater energy savings and also reduce the dependence on imported fuels. The penetration of large-scale renewables in Belarus may, however, be constrained by the commissioning of the NPP.

There is currently no target for nearly-Zero energy buildings (nZEB) in Belarus, though there are a number of measures aimed at improving the thermal performance of buildings, including standards for the construction of new buildings. These are discussed in Section 3.2. The adoption of nZEB for new construction in Belarus is a potential measure for the NEEAP.

12 See http://energoeffekt.gov.by/downloads/programs/program_psm248_2016_2020.docx
13 See http://minenergo.gov.by/wp-content/uploads/

2.4 Overview of energy savings measures 2016-2020

The following table summarises the types of measures that have been implemented or are planned in the State Energy Savings Programme which runs from 2016 to 2020

Table 2-4 List of measures implemented in 2016-2020

	Agriculture	Households	Industry	Energy Supply	Public sector	Services	Transport
State energy savings programme							
Boiler replacement	X	X	X	X	X	X	X
Decentralization of air supply compressors	X		X	X	X		X
Decentralization of exhaust air removal systems	X		X		X		X
Decentralization of heating	X		X	X	X	X	
Decentralization of refrigeration	X		X		X	X	
Decrease heat losses	X	X	X	X	X	X	X
Fuel switch (from electricity to local source)	X		X		X		X
Fuel switch (from electricity to natural gas)	X		X		X	X	X
Fuel switch (from liquid fuels to gas)	X		X		X	X	
Fuel switch (local source utilization)	X		X		X	X	
Heat supply optimization	X		X	X	X	X	X
Implementation of IT technologies	X		X		X	X	X
Increase energy efficiency in gas burning devices	X	X	X	X	X	X	X
Increase use of renewables for electricity production	X	X	X		X	X	
Increase use of renewables for heat production	X	X	X		X		
Installation of a new power plant (steam, gas, CHP)	X		X	X	X		X
Installation of automation of fuel combustion	X		X		X		X
Installation of cogeneration	X		X	X	X		X
Installation of frequency converters	X	X	X	X	X	X	X
Installation of new boilers using local fuel	X	X	X		X		
Installation of new energy-efficient technologies	X	X	X	X	X	X	X
Installation of new heat power plants using local fuel	X		X		X		
Installation of new power plants using local fuel	X		X		X	X	X
Insulation of buildings	X	X	X	X	X	X	X
Lighting	X	X	X	X	X	X	X
Management system	X		X	X	X		X
Metering	X	X	X	X	X	X	X
Other measures in boilers	X		X	X	X	X	X
Pump replacement	X		X	X	X	X	X
Other renewables	X		X		X	X	X
Sectoral Programme for the Development of the Electric Power Industry							
Replacement of inefficient power plants			X	X			
Replacement of power lines				X			
Reconstruction of substations				X			

Taken together these measures are expected to produce energy savings of **5,000 kt c.e.** by 2020. Anticipated savings from future State Energy Savings Programmes are discussed in the following Sections.

Other potential measures that could be undertaken in Belarus to achieve the 2030 targets are summarised in the following table. The measures are discussed in more detail in later sections of the NEEAP.

Table 2-5 New potential measures applicable in Belarus

	Agriculture	Households	Industry	Energy Supply	Public sector	Services	Transport
Planned measures							
Removing cross subsidies from households		X					
Metering and billing		X					
The ESCO concept in the social sector				X	X		
Insulation of buildings in the residential sector		X					
Modernisation of street lighting				X	X		
Waste to energy plant in Minsk					X		
Potential measures							
Carbon Tax	X	X	X	X	X	X	
Increase in Renewables			X	X	X	X	
Extension of the ESCO Concept			X		X	X	
Sustainable Energy and Climate Action Plan (SECAP)	X	X	X	X	X	X	X
Building Renovation Strategy		X			X	X	
Nearly Zero Energy Buildings (nZEB)		X			X	X	
The “Exemplary State” process					X		
Energy Management Systems (EnMS)			X				
White Certificates trades			X				
Technology and Green Procurement			X				
Sustainable Urban Mobility Plans (SUMP)		X			X	X	X
Eco-driving for Professional Drivers							X

Implementation of the above new measures, existing and planned measures should lead to the following primary and final energy savings.

Table 2-6 Overview of the estimates of primary and final energy savings achieved by existing, planned and new potential measures

	Primary energy savings (kt c.e.)	Final energy savings (kt c.e.)
2018- Achieved	0	0
2025 - Forecast	1,064	4,433
2030 - Forecast	1,891	11,578

The figures in the table above have been calculated using the LEAP (Long-range Energy Alternatives Planning) model[14] and are aggregated from the sector specific measures that are discussed in Section 3. Double counting of savings resulting from groups of measures are accounted for and eliminated in the LEAP modelling process. Annex C provides more details of the LEAP model.

[14] LEAP is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute. It was chosen for the NEEAP analysis because it allows modelling of greenhouse gas (GHG) emissions and was used by Belarus in the preparation of its Intended Nationally Determined Contributions (INDC) in its submission for the Paris Agreement.

3 PLANNED POLICY MEASURES TO ACHIEVE THE TARGETS

This section is aimed at bringing together information on all important energy efficiency measures adopted or planned to be adopted in Belarus to achieve the targets for 2025 and 2030 described in the previous section. The current and planned energy efficiency and renewable energy measures are described for each sector in addition to measures that affect all sectors (horizontal measures).

The analysis and presentation of measures planned for the NEEAP was developed by the Consultant with assistance of the Department of Energy Efficiency (DEE) and a Working Group that included representatives from:

- Ministry of Energy
- Energy Institute
- Ministry of Natural Resources and Environmental Protection
- Ministry of Housing and Communal Services
- Ministry of Antimonopoly Regulation and Trade
- National Statistical Committee of Belarus (Belstat)
- EBRD
- World Bank
- Energy Community Secretariat (EnCS).

In addition information on the NEEAP development was sent to the Ministry of Transport and Ministry of Economy to ensure that they were kept aware of progress.

The NEEAP was developed by the Consultant for government bodies in order to use it in implementing energy efficiency policies and developing RES in the context of possible further development of cooperation with the Energy Community, taking into account the application submitted by Belarus in 2016 for observer status in this organisation. NEEAP measures are outlined in the following sections.

3.1 Horizontal measures

3.1.1 Energy efficiency obligation scheme and alternative policy measures

Within the EU, Member States are required to set up an Energy Efficiency Obligation Scheme (EEOS) to meet the NEEAP targets, or to achieve the same amount of savings through alternative policy measures. Examples of EEOS in EU are described in Annex D. In the current period to 2020 an EEOS requires energy distribution companies to achieve annual energy savings of at least 1.5% within their final consumers. Belarus is not intending to establish an EEOS and will therefore set out to achieve the savings targets by alternative policy measures.

For Energy Community Contracting Parties, the new (2021-2030) savings target for EEOS[15] is to achieve cumulative end-use savings of at least 0.8% of annual final energy consumption averaged over the most recent three-year period prior to 1st January 2019. That requirement could be met by new policy measures that are adopted during the obligation period or through the continuation of existing measures (such as those in the State Energy Saving Programme).

Calculation methodology

EU Member States use the EUROSTAT database. Some of the Member States originally used the IEA methodology in preparation of their first NEEAP but because of European Commission objections they changed the calculation to the EUROSTAT methodology.

[15] Article 7 of the EED for the entire obligation period 2021-2030

The National Statistical Committee of the Republic of Belarus (Belstat) publishes an energy balance according to the EUROSTAT methodology. The most recent year for which energy balance is available is 2017. The final energy consumption of the Republic of Belarus in the most recent three years are as follows.

Table 3-1 Final energy consumption in the most recent three years

	2015	2016	2017
Final energy consumption [PJ]	733.03	743.37	761.57
Final energy consumption [kt c.e.]	25,018	25,371	25,992

Final energy consumption averaged over the 2015-2017 period is therefore **745.99 PJ (25,460 kt c.e.).**

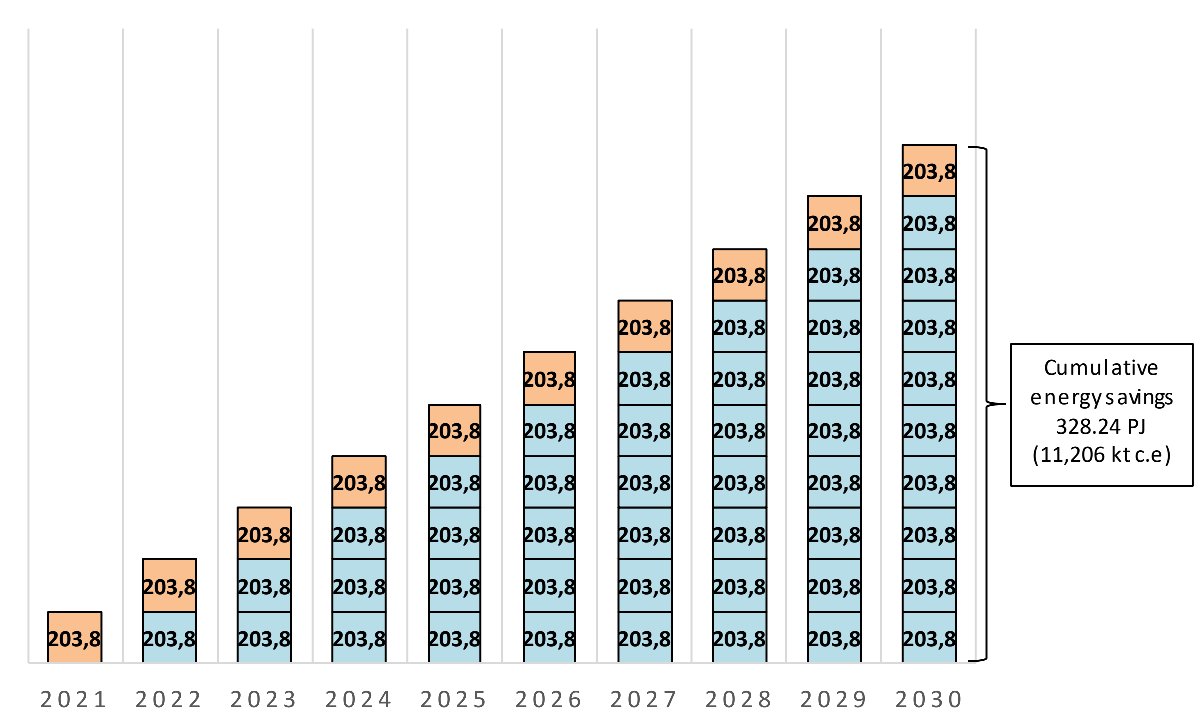
The requirement for new energy savings of at least 0.8 % per year is equivalent to 5.97 PJ (745.99 x 0.008=5.97). Therefore, in the period 2021-2030, 5.97 PJ of final energy consumption needs to be saved annually[16]. This target is also expressed in cumulative energy savings in the table below.

Table 3-2 Energy savings and cumulative energy savings in the period 2021-2030 according to the Article 7 target

Year		Final Energy Savings		Cumulative Final Energy Savings	
		[PJ]	[kt c.e.]	[PJ]	[kt c.e.]
2021	0.8%	5.97	203.8	5.97	203.8
2022	0.8%	5.97	203.8	11.94	407.5
2023	0.8%	5.97	203.8	17.90	611.3
2024	0.8%	5.97	203.8	23.87	815.0
2025	0.8%	5.97	203.8	29.84	1,018.8
2026	0.8%	5.97	203.8	35.81	1,222.5
2027	0.8%	5.97	203.8	41.78	1,426.3
2028	0.8%	5.97	203.8	47.74	1,630.0
2029	0.8%	5.97	203.8	53.71	1,833.8
2030	0.8%	5.97	203.8	59.68	2,037.5
Total		**59.7**	**2,038.0**	**328.2**	**11,206.4**

[16] According to the EED, countries shall decide how to phase the calculated quantity of new savings over each period, provided that the required total cumulative end-use energy savings have been achieved by the end of each obligation period. The EU methodology assumes a constant level of absolute savings each year rather than a fixed percentage of the reduced amount.

Figure 3-1 Calculation of the indicative national energy efficiency target for Belarus for the period 2021-2030



The **2030 target** is therefore to achieve final energy consumption savings of 5.97 PJ (203.8.0 kt c.e.) each year and 328.2 PJ (**11,206.4 kt c.e**.) of cumulative energy savings.

The interim **2025 target** is to achieve final energy consumption savings of 29.85 PJ (1,019.0 kt c.e.) in that year and 164.1 PJ (**5,603.2 kt c.e.)** of cumulative energy savings.

It is clear that the Article 7 savings target (11,206.4 kt c.e.) is significantly higher than the 32.5% (8,447 kt c.e.) required by Article 3 of the EED. However, for Contracting Parties it is the Article 7 target that is mandatory and Belarus will therefore adopt this target in line with EU Member States. The aim will be to achieve the target through ***alternative measures.***

3.1.2 Measures already adopted or planned

To provide context and background for the proposed NEEAP measures, this section gives details of the types of measures, the savings achieved or expected and the budgeted expenditure in the two State Energy Savings programmes from 2011-2015 and from 2016-2020.

State Energy Saving Programme for 2011-2015

On 24 December 2010 the Council of Ministers adopted the State Energy Saving Programme for 2011-2015. The goal of the Programme was to reduce energy intensity of national GDP by 29-30% within 5 years in comparison to the 2010 baseline. The main objectives of the Programme were:

- Increase of energy efficiency in all sectors;
- Deploy alternative and renewable energy sources;
- Achieve higher utilisation of combined heat and power plants;
- Increase the share of local energy fuels in boilers and furnaces.

The energy savings achieved from 2011 to 2015 were 7,788 kt c.e.

State Energy Saving Programme for 2016-2020

The State Energy Saving Programme continued after 2015 and a new indicator “share of renewable energy sources of gross consumption of fuel and energy sources” was introduced.

Table 3-3 Indicators of State programme on energy savings 2016-2020

No	Indicator	Unit	Planned	Achieved
1.	GDP energy intensity reduction	%	-0.5 (99.5)	+0.5 (100.5)
2.	Annual savings of fuel and energy resources due to the implementation of energy saving measures	kt of reference fuel/year	1,000	1,033.6
3.	Share of local fuel and energy sources of gross consumption of fuel and energy sources	%	14.5	15.6
4.	Share of renewable energy sources of gross consumption of fuel and energy sources	%	5.9	6.2

Energy saving targets for the 2016-2020 period were set to 5,000 kt c.e. (1,000 kt.c.e in 2016, 1,000 kt c.e. in 2017, 900 kt c.e. in 2018, 1,000 kt.c.e in 2019 and 1,100 kt c.e. in 2020). The allocated budget for the whole period is 11,045,778 th. BYN. 2,409,769 th. BYN has been spent in the period 2016-2017.

The savings achieved through various measures already implemented in 2016 and 2017 are shown in the following table.

Table 3-4 Energy savings achieved in 2016 and 2017 in the State Energy Saving Programme

Measures	2016	2017
	kt c.e.	kt c.e.
Implementing of modern energy efficient and increasing the energy efficiency of existing technologies, processes, equipment and materials in production processes	289.8	276.9
Heat supply optimisation	173.1	183.7
Installation of new energy efficient generating capacity	92.6	47.8
Implementing of automatic lighting control systems and energy efficient lighting devices, zoning of lighting	44.3	53.7
Increasing efficiency of boilers and process furnaces	42.4	50.7
Improving thermal properties of building structures and housing stock	42.7	35.0
Increased use of local energy resources (including renewables)	208.9	94.7
Other[17]	277.7	291.1
Total	**1,171.5**	**1,033.6**
Planned	**1,000.0**	**1,000.0**

Source: DEE database

According to the DEE reporting data for 2017, 1.28 bn. BYN were spent on the implementation of the overall energy-saving measures complex of the State Energy Saving Programme from all sources of financing, against a planned expenditure of 2.03 bn. BYN. The source of funding is presented in the table below.

[17] Includes around 30 categories of smaller measures

Table 3-5 Financing of the State Energy Saving Programme in 2017

Sources of Finance	Plan	Spent	Percentage of the plan	Percentage of the total spent
	12 months th. BYN	12 months th. BYN	%	%
State Budget	73,720	90,544	122.8	7.1
Including:				
Funds for capital investment financing (social sector)	*59,996*	*77,716*	*129.5*	*6.1*
Funds for state program financing (other sectors)	*12,184*	*11,938*	*98.0*	*0.9*
Returned Funds previously allocated	*1,540*	*890*	*57.8*	*0.1*
Local Budgets	304,500	164,946	54.2	12.9
Including:				
Funds for financing the construction of energy facilities using local fuels (including RES)	*21,592*	*14,333*	*66.4*	*1.1*
Extra-budgetary funds (investment funds)	16,745	12,190	72.8	0.9
Other Sources:				
Own funds of organisations	911,725	829,879	91.0	64.8
Loans	571,170	153,454	26.9	12.0
Other sources (including IFIs)	152,440	29,262	19.2	2.3
Total	**2,030,300**	**1,280,275**	**63.1**	**100.0**

Source: DEE database

As can be seen above, funding from organisations' own funds is by far the biggest source of finance. The investment efficiency in individual measures in the State Energy Saving Programme are shown below.

Table 3-6 Investment efficiency of implemented measures in State Energy Saving Programme 2016-2017

Measures	Share of total energy saving	Investments efficiency BYN/t c.e.	Priority measure for 2021-2030[18]
Final energy saving measures	**81.6%**	**876**	
Fuel switch (from electricity to local source)	<0.1%	48	X
Implementation of IT technologies	<0.1%	341	
Other measures[19]	19.6%	377	X
Other measures in boilers	2.2%	380	
Increase energy efficiency in gas burning devices	0.5%	482	
Pump replacement	2.3%	560	X
Metering	1.2%	605	X
Heat supply optimization	11.2%	612	X
Lighting	5.2%	624	X
Decentralization of air supply with the installation of local compressors	0.2%	629	
Fuel switch (from electricity to natural gas)	<0.1%	770	
Decentralization of refrigeration with the installation of local refrigeration	<0.1%	827	
Fuel switch (local source utilization)	<0.1%	838	X
Installation of new energy-efficient technologies	29.8%	1,104	X

[18] Based on the consultant's analysis
[19] Combination of several measures

Measures	Share of total energy saving	Investments efficiency BYN/t c.e.	Priority measure for 2021-2030[18]
Boiler replacement	1.8%	1,186	X
Energy management system	1.1%	1,260	X
Installation of new boilers using local fuel (biomass)	0.3%	1,362	X
Decentralization of heating	<0.1%	1,450	
Installation of frequency converters	1.9%	1,563	
Insulation of buildings	4.1%	2,657	X
Waste heat utilization in technological processes	<0.1%	2,764	
Fuel switch (from liquid fuels to gas)	<0.1%	3,539	
Primary energy saving measures	**16.7%**	**2,670**	
Installation of automation of fuel combustion	<0.1%	993	
Installation of cogeneration	<0.1%	1,195	X
Decentralization of exhaust air removal systems with the installation of local suction	1.3%	1,581	
Installation of a new power plant (steam, gas, CHP)	<0.1%	1,725	
Decrease heat losses	7.4%	3,987	
Renewables saving measures	1.7%	6,084	
New measures for 2021-2030			
Installation of heat pumps		420	X
Installation of solar photovoltaic		800	X
Installation of solar thermal systems		1,000	X

Source: DEE database

81.6% of total energy savings were achieved through final energy saving measures, 16.7% from primary energy saving measures (energy supply) while the remaining 1.7% was achieved through the use of renewables, mainly for heat production from biomass.

The measures marked as 'priority' for future programmes have been chosen for one or more of the following reasons:

- They provide a relatively large share of the savings with a good level of investment efficiency, (i.e. savings achieved per BYN invested). For example these measures include installation of new energy efficient technologies, heat supply optimisation, lighting and the range of 'other measures';
- They have lower levels of investment efficiency but make sense when implemented alongside other measures (e.g. insulation of buildings as part of wider rehabilitation, cogeneration as part of district heating improvements);
- They contribute to the energy security goal (e.g. fuel switching to local sources).

The new renewables measures for both heat and electricity are also a priority both for energy saving (on site renewables) and reducing the reliance on imported fuels (supply side renewables).

In general it can be stated that the State Energy Saving Programme is implementing cost effective measures. Less cost effective measures are implemented only in combination with more effective measures. However there is still potential for new technical measures to be implemented in State Energy Saving Programme. These include:

- *Heat Pumps* - Installation of heat pumps could be an effective measure especially where no local fuel (biomass) is available or where there is an available source of low grade heat (see below). The investment efficiency of heat pumps varies from 340 BYN/t c.e. up to 500 BYN/t c.e. depending on type of heat pump and coefficient of performance.
- *Solar Photovoltaic (PV)* – which converts sunlight directly to electricity. The PV system is usually connected to the grid, either through small-scale rooftop systems installed on commercial or residential properties, or through larger scale, ground-mounted 'solar farms'. The investment efficiency is around 800 BYN/t c.e.

- *Solar Thermal* systems for water heating reduce fossil fuel consumption. In the residential sector, solar thermal systems can account for as much as 30% of water heating consumption. It could also be applicable in hospitals, schools, administrative buildings and in industrial buildings. The investment efficiency of solar thermal systems is around 1,500 BYN/t c.e.

The wider use of heat pumps in future programmes is of particular interest to the DEE. Sources of low grade heat are numerous in thermal power plants where cooling water is used for service equipment such as oil coolers and condensers, and in industries such as chemicals, petrochemicals and food production where process cooling is required. Higher grade heat is available in boiler flue gases in both power plants and industry. The development of commercial lithium bromide absorption heat pumps has extended the temperature range over which the technology can be used. Several pilot projects and feasibility studies[20] have recently been implemented in Belarus and show great promise in terms of both energy savings and economic effectiveness.

State Energy Saving Programme for 2021-2025

It is anticipated that there will be another State Energy Saving Programme for 2021-2025 but the budget has not yet been determined. However the DEE expects that an increase of 10% in the budget will be needed to implement energy saving measures that achieve 5,000 kt c.e. over 5 years as in the State Energy Saving Programme for 2016-2020. This is because the most cost-effective measures will already have been implemented in the previous programmes. The NEEAP will play an important role in informing the new State Energy Saving Programme.

The total energy savings of 5,000 kt c.e. are expected to be made up of:

- Cumulative final energy savings: 4,000 kt c.e.
- Cumulative primary energy savings: 875 kt c.e. (e.g. installation of small cogeneration units, heat losses reduction in heat pipes)
- Cumulative renewables: 125 kt c.e.

When accumulated over 10 years to 2030 as in the EU methodology the total energy savings are expected to be 9,165 kt c.e and the final energy savings should be 7,520 kt.c.e.

The expected cumulative CO_2 savings are 2,373 kt.[21]

The investment cost is likely to be around 9.28 bn. BYN.

In the area of energy saving the Republic of Belarus is actively co-operating with international organisations, financial institutions and funds, such as the World Bank (WB), the European Bank for Reconstruction and Development (EBRD), the Global Environmental Facility (GEF), the UN Economic Commission for Europe (UN ECE) and the UN Development Programme (UNDP). Details of previous, current and planned projects are provided in the sectoral discussions below.

State Energy Saving Programme for 2026-2030

Even after three State Energy Savings programmes it is likely that there will still be significant savings potential from implementing similar ‘conventional’ measures, though the measures to be implemented need to be the subject of a review of the programme prior to its adoption. In this period the total energy savings are estimated at 4,000 kt c.e. made up of:

- Cumulative final energy savings: 3,300 kt c.e.
- Cumulative primary energy savings: 575 kt c.e.
- Cumulative renewables: 125 kt c.e.

The expected cumulative CO_2 savings are 2,367 kt.

The anticipated investment cost is around 8.02 bn. BYN.

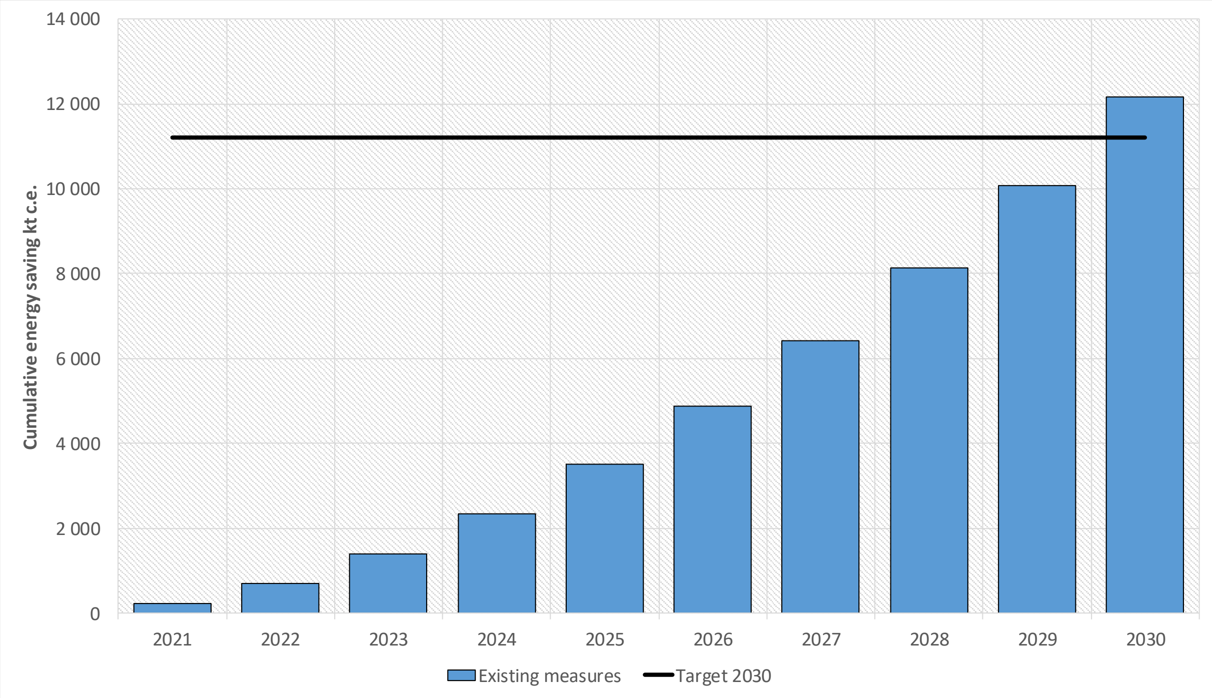
In addition to the above ‘technical’ savings it is estimated that improved energy awareness education and training will contribute savings of 275 kt c.e. of final energy savings over the 10 year period at a cost of some 200 mln. BYN.

[20] For example at: Mozyrskaya TPP - Mozyr Oil Refinery; OJSC Svetlogorsk Khimvolokno; Mozyrsol OJSC; Granit RUPE *(Source: DEE)*

[21] CO_2 savings were calculated using emission factors (see Annex F) in the LEAP model (see Annex C)

Hence the **total** energy savings (including renewables) from the extension of existing programmes is expected to be **12,595 kt c.e.** However, the NEEAP follows the EED Article 7 target which is based on final energy savings and this figure is expected to be **10,122 kt c.e**. against a target for Belarus of **11,206 kt c.e.** This is illustrated in the diagram below.

Figure 3-2 Total energy saving in the period 2021-2030 – existing measures



New planned measures

In addition to the extension of existing measures in the State Energy Saving Programme and increased renewables, a number of other new programmes are planned. The anticipated savings from these measures are outlined below and the measures themselves are discussed in more detail in the appropriate later sections of the NEEAP.

Removing cross subsidies from households

Removing cross subsidies is a stated goal of the Belarusian government (see section 3.7.1)[22]. It would motivate consumers to change their behaviour to save energy and to implement zero-cost and low-cost measures.

Calculation methodology: Cumulative energy savings in the period of 2021-2030 are calculated based on final energy consumption of the residential sector in 2017. The following assumptions were made:

- Final energy consumption in the residential sector for heating in 2017: 4,388 kt c.e.
  The energy saving technical potential is 55%[23] of final energy consumption for heating in the residential sector 4,388 x 0.55 = 2,413 kt c.e.
- In the long term 15% of the technical potential can be achieved by removing cross subsidies.
  2,413 x 0.15 = 362 kt c.e.
- By 2030 only 20% of this potential will be achieved.
  362 x 0.2 = 72.4 kt c.e.

Hence by 2030, the cumulative final energy savings from this measure would be 398 kt c.e. as illustrated below.

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
7.2	14.5	21.7	29.0	36.2	43.4	50.7	57.9	65.2	72.4	**398**

[22] Comprehensive Plan for the Development of the Electric Power Industry until 2025
[23] Based on experience in the Czech Republic

CO_2 savings were calculated using emission factors (see Annex F) calculated in the LEAP model.

Table 3-7 Removing cross subsidies from households – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	398 kt c.e.
Cumulative CO_2 savings	774 kt
Investment costs[24]	214 mln. BYN

Household consumer expenditures spending on housing and utilities in 2018 were 7.3 %[25] of total expenditures which were 16,757 mln. BYN[26]. Removing cross subsidies would lead to higher costs paid by households in the period 2021-2030 of 5,342 mln. BYN. The state could provide subsidies for low income households (4.0 % of households in Belarus are considered to be low income households[27]), which would amount to 214 mln. BYN.

Metering and billing

Providing householders with electricity and gas meter devices provides direct access to information about their energy consumption and enables residents to control and manage their energy use and savings. Around 80% of residential buildings in Belarus are already equipped with metering devices, though only around 20% of individual apartments are separately metered. It is estimated that by 2025 all buildings will be equipped with metering devices covering all types of energy sources. This will bring about savings through the actions of building occupants as they react directly to the energy cost signals from the new metering.

Calculation methodology: The calculation methodology was evaluated on the basis of aforementioned assumptions, including additional assumption for energy savings up to 10% by 2030 in buildings that do not have metering and billing devices. Cumulative energy savings (2021-2030) are calculated based on heat energy consumption in the household sector in 2017. Implementing this measure can result in annual energy savings of approximately 88 kt c.e. by 2030.

Final energy consumption in the residential sector for heating: 4,388 kt c.e.

Final energy consumption in buildings not equipped with metering devices: 4,388 x 0.2 = 878 kt c.e.

10% energy savings potential: 878 x 0.1 = 87.8 kt c.e.

The cumulative savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
17.6	35.1	52.7	70.2	87.8	87.8	87.8	87.8	87.8	87.8	**702**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-8 Metering and billing – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	702 kt c.e.
Cumulative CO_2 savings	1,366 kt
Investment costs	150 mln. BYN

[24] Costs for the State providing subsidies for low income households
[25] http://www.belstat.gov.by/en/ofitsialnaya-statistika/social-sector/uroven-zhizni-naseleniya/godovye_dannye/rate-of-low-income-households/
[26] http://www.belstat.gov.by/en/ofitsialnaya-statistika/ssrd-mvf_2/natsionalnaya-stranitsa-svodnyh-dannyh/
[27] http://www.belstat.gov.by/en/ofitsialnaya-statistika/social-sector/uroven-zhizni-naseleniya/godovye_dannye/rate-of-low-income-households/

The ESCO concept in the Social Sector

The initial ESCO scheme in Belarus will be aimed at the social sector (schools, hospitals etc).

Calculation methodology: Cumulative energy savings in the period of 2021-2030 are calculated based on final energy consumption of services in 2017. The following assumptions were made:

- 70% of total final energy consumption of services are buildings,
- 10% of all buildings in services are schools and hospitals,
- The energy saving economic potential is 55% of final energy consumption for heating.

The calculation of cumulative energy saving assumes that 20% of the economic potential will be implemented by 2030. Hence by 2030, a cumulative 109 kt c.e could be achieved in final energy savings in the social sector.

Final energy consumption in schools and hospitals for heating: 180 kt c.e.

The energy saving potential: 180 x 0.55 = 99 kt c.e.

20% of the economic potential will be achieved in 2030: 99 x 0.2 = 19.8 kt c.e.

The cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
2.0	4.0	6.0	7.9	9.9	11.9	13.9	15.9	17.9	19.8	**109**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-9 The ESCO concept in the Social Sector – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	109 kt c.e.
Cumulative CO_2 savings	193 kt
Investment costs	360 mln. BYN

Insulation of buildings in the residential sector

Insulation of buildings in the residential sector could be financed through the recently adopted decree on improving the energy efficiency of multi-apartment buildings (the state will co-finance up to 50% of the thermal modernisation), by IFIs and the planned new “Super ESCO”[28] and may be added to future State Energy Savings Programmes.

The energy saving economic potential has been calculated in the BelSEFF project as 55 % of final energy consumption for heating in the residential sector. 30% of the economic potential can be achieved by insulating the residential buildings. The costs were taken from similar projects in other Central and Eastern European countries. The calculation of cumulative energy saving assumes that 20% of potential will be implemented by 2030.

Calculation methodology: Cumulative energy savings in the period of 2021-2030 are calculated based on heat energy consumption in the household sector in 2017 by implementing the economic potential of insulation of buildings. By 2030, 145 kt c.e could be achieved in final energy savings in the residential sector and cumulative savings would be 796 kt c.e as illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
14.5	29.0	43.4	57.9	72.4	86.9	101.4	115.8	130.3	144.8	**796**

[28] See Section 3.1.7

Table 3-10 Insulation of buildings in the residential sector – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	796 kt c.e.
Cumulative CO_2 savings	2,790 kt
Investment costs	2,058 mln. BYN

Modernisation of street lighting

The aim of this measure is to reduce the share of street lighting in the total electricity consumption of the country, to reduce light pollution and at the same time, stimulate the market for LED lighting and energy services. Projects for improving energy efficiency in street lighting are feasible, the savings are instantly visible and easily demonstrable and verifiable. Public bodies will be required to purchase only energy efficient lighting when installing or replacing lighting.

Modernisation of street lighting is ideally suited to the ESCO concept because of the highly predictable level of savings. Implementation of LEDs and control systems for street lighting could lead to 40 % of electricity savings. For calculation the data of final energy consumption on street lighting (600 GWh) and the 40 % of expected savings were used. With the introduction of this measure in Belarus, it is estimated that 2.9 kt. c. e. of annual final energy savings will be achieved. The cumulative savings from 2021 to 2030 would then be 162 kt. c.e.

Final energy consumption of street lighting: 74 kt c.e.

40% of energy savings potential: 74 x 0.4 = 29.5 kt c.e.

The cumulative energy savings to 2030 are shown below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
2,9	5,9	8,8	11,8	14,7	17,7	20,6	23,6	26,5	29,5	**162**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-11 Modernisation of street lighting – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	162 kt c.e.
Cumulative CO_2 savings	590 kt
Investment costs	562 mln. BYN

Waste to Energy Plant in Minsk

In addition to the above broad projects that apply throughout Belarus, there is one specific planned project that should provide significant energy savings. This is the **Waste to Energy Power Plant in Minsk.**[29]

Development of a waste to energy plant in Minsk with a capacity to handle 500,000 tonnes/year of waste is recommended in the National Strategy for the Management of Municipal Solid Waste and Secondary Material Resources. Investments costs are estimated at 660 mln. BYN. 60% of the waste will be recycled and 40 % will be used for energy generation. The power plant will produce 1,080 TJ of heat and 60 GWh of electricity annually.

Calculation methodology:

[29] Waste to Energy is not normally covered in EU NEEAPs but it is included here because of the primary energy savings it will produce and because it will decrease the amount of imported gas, thus improving energy security.

Based on the projected capacity, the waste to energy plant in Minsk will produce 1,080 TJ of heat and 60 GWh of electricity (44.2 kt c.e. a year) annually from 2022. In the period of 2022 – 2030, 398 kt c.e. of cumulative primary energy savings could be achieved after plant commissioning as illustrated below.

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0,0	44,2	44,2	44,2	44,2	44,2	44,2	44,2	44,2	44,2	**398**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-12 Waste to Energy Plant in Minsk – energy savings, CO_2 savings and costs

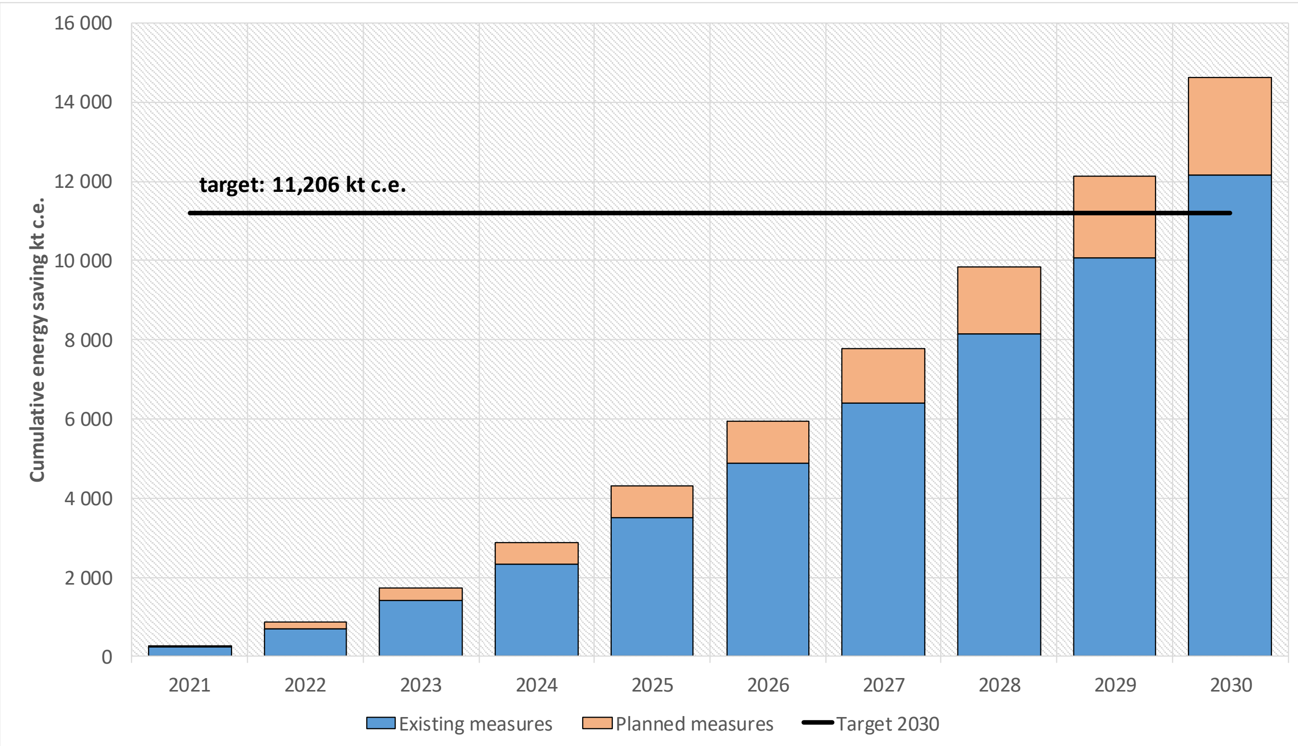
Period of implementation	2022-2030
Cumulative savings in primary energy	398 kt c.e.
Cumulative savings recalculated to final energy	281 kt c.e.
Cumulative CO_2 savings	774 kt
Investment costs	660 mln. BYN

New planned measures summary

The total **final and primary** energy savings expected from the new planned measures is therefore **2,448 kt c.e.** in the period to 2030.

Hence the total anticipated **final and primary** energy savings from the existing and new planned measures is **14,620 kt c.e.** (or 130 % of the Article 7 target 11.206 kt c.e.). This is illustrated in Figure 3-3 below.

Figure 3-3 Total energy saving in the period 2021-2030 – existing and planned measures



New potential measures are discussed in later sections of this document.

3.1.3 Energy audits and management systems

The EU Energy Efficiency Directive that has been used as guidance in preparing the NEEAP provides that, with a view to energy efficiency improvement in industry and buildings, it is necessary to introduce energy audits or energy management systems, to activate the role of the sector association for promoting energy efficiency and to initiate a discussion for determining energy consumption benchmarks by sectors.

Belarus introduced compulsory energy audits as an alternative policy measure for the pursuit of energy savings targets under Law on Energy Savings in 2015. The obligation to conduct energy audits was laid down for industrial enterprises and agricultural holdings depending on their total annual energy consumption. The Law establishes mandatory energy audits every 5 years for legal entities with annual energy consumption of more than 1,500 t c.e. The aim of the audits is to assess the energy efficiency and the potential for energy saving, to develop proposals for energy consumption targets, determine possible measures for improving energy efficiency, and develop an energy performance certificate for the legal entity. Up to 2018 around 400 such audits have been carried out and the programme envisages a further 100 audits per year[30].

The energy audit is to be carried out by an independent entity, which has knowledge and professional experience in performing this type of audits. Energy audits are to cover detailed and validated calculations for the proposed measures, which are designed to improve energy efficiency, and to provide information on potential energy savings. It should also include measures to increase the use on local energy sources, including renewables.

The energy audit of an enterprise must:

- be carried out on the basis of up-to-date, measured, and traceable data on energy consumption and, (for electricity) load profiles;
- comprise a detailed review of the energy consumption profile of buildings or groups of buildings, in industrial installations, and in transportation;
- should propose energy efficiency measures based on life-cycle cost analysis (LCCA), simple payback period (SPP) and discounted payback period (DPP) in order to take account of long-term savings, residual values of long-term investments and discount rates.

Operators are required to keep the data used in energy audits for a five-year period, for control purposes.

The Law sets mandatory and decreasing rates of fuel and energy resource consumption for the legal entities subject to the energy audits. The rates are set in energy audits and can be also found in the five year State Energy Efficiency programmes.

Each energy audit must be approved by the Department of Energy Efficiency who maintain the State register of audits. Measures included in the energy audit have to be implemented according to the 5-year plan specified in the audit.

The requirements for audits, what should be included, the subsequent monitoring and the qualifications of auditors is already in line with the EU requirements. However, there is a need for support for implementing measures and for energy management systems both at the enterprise and the municipal level. For municipalities a recent (2017) EU programme called "50000&1 SEAPs"[31] specifies how to implement energy management systems into Sustainable Energy Action Plans (SEAPs) with the aim of ensuring that sustainable approaches to local energy policy and planning are spread and strengthened further across Europe.

The possibility of replacing mandatory energy audits with the introduction of a certified energy management system (certification to the ISO 50001 energy management system) is not mentioned in the law. ISO 50001 is currently voluntary and has been implemented by a few enterprises. The use of ISO 50001 as an extension to the current audit scheme is a potential measure as part of improving energy management systems, including implementation at the level of city and district administrations, For municipalities, it is also possible to focus on the new standards of the ISO 37100 series defining general strategic directions and ISO 37120:2018[32], which defines a set of indicators for city services and quality of life (including indicators for the energy sector).

[30] http://energoeffekt.gov.by/downloads/supervision/inspection/2019_grafik_audit.xls
[31] http://www.50001seaps.eu/home/
[32] https://www.iso.org/standard/68498.html

3.1.4 Metering and billing

Since 2000, Belarus has consistently improved the metering and billing of all types of energy sources. Improving the metering and billing of individual consumers in all sectors brings about savings because their energy costs are then directly related to their own actions (as opposed, for example, to the behaviour within a whole residential block). They will therefore be motivated to take actions that suit their individual lifestyles to reduce energy consumption and hence cost.

The details of existing metering programmes are provided below.

Electrical Energy

According to the instructions No. 69 *"On the procedure and conditions for equipping consumers and electrical energy producers with metering devices for logging consumption",*[33] approved by the Ministry of Energy in December 2011, all newly installed metering devices must have:

- An electronic display that allows for displaying the accounting and service information stored in the memory of the metering device;
- An optical port;
- At least two passwords for accessing the settings and parameters;
- An event log.

It is planned that by 2023, all existing induction meters will be replaced by electronic meters integrated into the ASCME systems (Automated System for Control and Accounting for Electricity). As of January 2019, the percentage of metering equipment with electronic devices was as in the table below.

Table 3-13 Percentage of electronic electricity meters by Region

Region	Single-phase		Three-phase	
	Total	% electronic	Total	% electronic
Brestskaya	605,223	49	113,570	73
Vitebskaya	599,435	45	80,726	62
Gomelevskaya	700,257	51	68,777	67
Grodnenskaya	517,000	52	76,245	59
Minskaya	1,536,934	49	220,597	59
Mogilevskaya	528,296	45	50,338	68
Total	**4,487,145**	**49**	**610,253**	**64**

Hence it can be seen that around 51% of single phase meters and 36% of three-phase meters still need to be replaced.

Heating Energy

According to the approved Concept of Heat Supply Development[34] during the construction of new buildings and major refurbishments of existing industrial, public and residential buildings, heating and domestic hot water (DHW) systems must be equipped with metering devices for heat consumption. When residential buildings are designed, it is necessary to provide heat metering in each apartment and the facility to connect the meter to the system for collecting and transmitting data to a central point. The ultimate aim is for the automation of heat and DHW consumption systems and the installation of energy consumption metering to create a single system for monitoring and metering energy consumption in buildings.

According to the design standards that have been in force since 2003, in apartment buildings it is necessary to install devices for individual apartment-based regulation and metering of heat for space heating and DHW.

[33] http://minenergo.gov.by/dfiles/000441_944900_69.doc

[34] https://www.brestenergo.by/docs/conctepsnab.pdf

In addition heat metering devices should be installed for the building as a whole, providing separate metering of the energy used for space heating and DHW. In public spaces located in residential buildings, heat control and metering devices should be installed for each individual enterprise and institution. In single-storey and separate residential blocks, metering should be provided for regulating and recording of heat consumption for heating, ventilation and hot water supply.

As of January 2019 all residential buildings of 20 apartments or more were fully (100%) equipped with building level metering devices, whilst individual metering was installed in around 20% of apartments. Potential savings from extending metering to all apartments were described in 3.1.2.

Natural Gas

All industrial consumers and commercial enterprises with a gas supply are equipped with gas metering devices. In addition, all apartments and residential buildings where gas is used for heating and hot water are equipped with gas meters, though some apartments that use gas only for cooking are not metered. The total number of apartments that are using natural gas and the numbers that are metered are shown in the following table:

Table 3-14 Number of Apartments with Gas metering (by Region)

Region	No of Apartments Using Gas	Number of apartments equipped with metering devices
Brestskaya	452,014	357,083
Vitebskaya	367,263	242,490
Gomelevskaya	507,367	369,802
Grodnenskaya	342,533	273,711
Minsk city	524,862	299,776
Minskaya	377,905	293,219
Mogilevskaya	337,545	255,055
Total	**2,909,489**	**2,091,136**

This implies that 818,353 apartments (around 28% of the total) are using gas only for cooking.

Cooling

There are currently no district cooling systems in Belarus though one new cooling, heat and power plant (CCHP) is being financed by EBRD at the Polesie manufacturing company – the largest manufacturer of high quality children's plastic toys and games (see Section 3.10.4). The consumption of individual air conditioning/cooling devices in buildings is included in their overall metered electricity usage.

Summary

Overall the current and planned metering arrangements are in line with the EU guidance. There is still some way to go in replacing electricity meters with electronic types and in heat metering for individual apartments but these are part of an ongoing programme and should be completed by 2025. Metering of apartments using gas only for cooking is less important because the consumptions are relatively low. Anticipated savings are 18 kt c.e. per year from 2021 to 2025. Estimated investments costs are 150 mln. BYN.

3.1.5 Consumer information programmes and training

General education and awareness programmes

Belarus has established a multi-level system of education in energy efficiency and energy saving for the general public and energy specialists. These include:

- Educational games in kindergartens, thematic lessons, competitions and energy marathons at secondary schools;
- The Fundamentals of Energy Saving specialty at institutions of higher education;

- Introducing an Energy Efficient Technologies and Energy Management specialty at four institutions of higher education;
- Numerous professional development courses.

Systemic measures implemented in the country include international and national exhibitions, forums and conferences, awareness raising and educational workshops and training courses at the regional and sectoral levels, month and day campaigns on energy and energy efficiency, thematic campaigns, media tours, press conferences, online conferences on the rational use of energy resources and the best practices for introducing energy efficient technologies.

Permanent exhibitions have been arranged, as well as museums dedicated to energy saving being set up in a number of cities and educational institutions. There are a number of thematic publications such as the research journal "Energy Efficiency" and educational books on the rational use of energy resources for children, as well as training and methodological papers and reference guides. In addition, some small information and educational centres on energy and resource efficiency have been established in kindergartens and schools, though in some cases there is a shortage of resources and equipment.

Awareness raising and educational initiatives are being implemented through mass media and social advertising.

Industry and Buildings

The mandatory energy audits for large industrial enterprises and buildings include specific information on improving energy efficiency for owners and occupiers as described in Section 3.1.3 above. Energy Managers in these enterprises are required to attend a mandatory course on energy efficiency.

Smaller enterprises and buildings are not covered by the mandatory audit scheme and up to now there have been no education and awareness programmes aimed specifically at SMEs. Introducing support on a voluntary basis for this sector of industry would be a useful addition to the programme.

Energy Managers

Additional training courses for energy managers would assist them in implementing the measures proposed in the energy audits as well as energy management systems. It should include training in energy management at the city and municipal levels, advanced training of senior officials in the field of sustainable energy development at the level of regions and cities.

3.1.6 Availability of qualification, accreditation and certification schemes

All energy auditors undertaking mandatory audits in qualifying enterprises are required to hold a Certificate of Professional Competence. The assessment for this is governed by the requirements of STB 2321-2013 *"Energy auditors experts. Requirements for professional competence."* The General requirements of the certifying procedures are defined in the Rules for Confirmation of Compliance of the National System for Attestation of Conformity of the Republic of Belarus, approved by a resolution dated July 25, 2017.

The certification process includes:

- filing an application form for certification with all required documentation:
- analysis by the certification authority of the accuracy of the application and the accompanying documentation;
- sitting a written qualification examination;
- if successful, confirmation, registration and issue of a certificate of competence;
- periodic assessment of certified staff competence.

Currently there are 250 auditors certified to undertake the mandatory audits[35].

[35] https://tsouz.belgiss.by/#!/certp/certifs

3.1.7 Energy Services

Several small ESCO-type companies are operating in Belarus. These companies have implemented a number of projects on small combined heat and power (CHP) generation plants for large industrial companies and for housing and communal services companies. They provide turnkey contracts, including the supply, installation and operation of energy-saving equipment. The company owns the facility during the project and sells electricity and heat at a lower price. After completion of the contract ownership of the installation is transferred to the customer.

The ESCOs operating In the Belarusian market and the projects they have implemented are summarised below:

CJSC "BelinvestEsko" (2005, co-founders Belinvestbank and private company «Energy Saving Programs Limited», currently in the liquidation process)

- Mini-CHP for OJSC "Berezastroimaterialy";
- Mini-CHP at the boiler house "Lida-46";
- Mini-CHP at the boiler house № 1 of the Smorgon RUP "Housing and Communal Services"

CJSC «Vneshenergoservis» (2007, co-founder Bank BelVEB)

- Cogeneration unit for OJSC "Krasnoselskstroymaterialy" (5 MW)

JLLC "Center for New Technologies" Connecticum"

- Cogeneration unit for OJSC "Gomelsteklo" (2.5 MW)

TES DKM GROUP (Teploenergoservice DKM LTD) implementing EPc/ESCO projects in Belarus through Interregional Energy Company Ltd. (IEC Ltd)

- Development and operation of mini-CHP and boiler plant for Kalinkovichi dairy plant: CHP unit with gas engine, power output of 0.77 MWe and heat output of 0.92 MWt and two steam condensing boilers using natural gas (6.55 MWt each)

As is evident from the above, the market for Energy Service Companies (ESCOs) in Belarus is currently in its infancy and there is undoubtedly more scope for this type of activity.

Under the EU4Energy Programme a project on the development of regulatory legal acts for energy performance services (EPC/ESCO) has been completed and the draft ESCO concept has already been developed by consultants. This will result in a Presidential Decree on ESCOs, along with secondary regulation introducing guidelines and template contracts. The regulation should provide opportunities for private investments and allow for EPC contracts in the social sector, especially for energy and thermal rehabilitation of schools, state medical centres etc.

An EPC/ESCO scheme is also being prepared for the residential sector. A “SuperESCO” approach for residential EPC projects has been chosen. It provides the option of an energy services market concentrated under the roof of a public/state-owned entity (e.g. BelESCO) which would maintain control over the whole project lifecycle. It could be initiated within one year, requiring little effort in amending the current legislation and changing the existing operational setups. The initiative proposes the establishment of a public “SuperESCO” which will be created under the roof of a state bank (Belarusian Development Bank). Strong technical support for this scheme is anticipated.

3.1.8 Energy Efficiency National Fund

There are no plans to set up an Energy Efficiency National Fund in Belarus at the moment but the current State Programme for Energy Saving has a dedicated budget for implementing energy efficiency measures across all sectors and so fulfils a similar function.

Discussions are ongoing with the World Bank on the possibility of establishing a national fund for the Buildings sector.

Other potential sources of finance for implementing the recommended measures are discussed in the following Sections.

3.1.9 Other energy efficiency measures of a horizontal nature

Other horizontal measures discussed with the Working Group are described below.

Extension of the ESCO Concept

An Energy Service Company (ESCO) is a useful mechanism for organisations who do not wish to or cannot use their own financing or personnel for energy efficiency improvements. The organisations pay back the investment made by the ESCO from savings resulting from the reduction in energy consumption.

In Belarus the regulatory mechanism has been established for the first stage of operation of ESCOs, aimed at the social sector (hospitals, schools etc). The proposed "SuperESCO" will be aimed at the residential sector. Within the EU the majority of ESCO schemes have been installed at public sector buildings and for some industrial processes. There is scope in Belarus to expand the ESCO concept to these areas.

Based on an EU report for DG Energy on Energy Savings Calculation Methods[36] the potential energy savings from ESCOs involvement in public buildings and in the industry sector are 55% and 40%, respectively. However, due to the difficultness of implementation, there is an assumption that the economic potential of the measure will be realised at 20% of the potential for public buildings and buildings in the industry sector by 2030.

With the introduction of this measure for public buildings and buildings in industry, annual savings could be 4 kt c.e. and 6 kt c.e, respectively. This calculation was based on the final energy consumption (Belstat, 2017) and the above percentage of energy savings.

Final energy consumption in public buildings for heating: 361 kt c.e.

The energy saving potential: 361 x 0.55 = 198 kt c.e.

2% of the economic potential will be achieved annually: 198 x 0.02 = 3.97 kt c.e. Cumulative energy savings will be 179 kt c.e. as illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0,0	4,0	7,9	11,9	15,9	19,8	23,8	27,8	31,7	35,7	**179**

Final energy consumption in industry buildings for heating: 747 kt c.e.

The energy saving potential: 747 x 0.4 = 299 kt c.e.

2% of the economic potential will be achieved annually: 299 x 0.02 = 5.98 kt c.e. Cumulative energy savings will be 269 kt c.e. as illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0,0	6,0	12,0	17,9	23,9	29,9	35,9	41,8	47,8	53,8	**269**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F)

Table 3-15 Extension of the ESCO Concept– energy savings, CO_2 savings and costs

	Public buildings	Buildings in industry
Period of implementation	2022-2030	2022-2030
Cumulative energy savings	179 kt c.e.	269 kt c.e.
Cumulative CO_2 savings	318 kt	465 kt
Cumulative costs	590 mln. BYN	889 mln. BYN

[36] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC99698/report%20on%20eed%20art%207%20-%20publishable.pdf

Investment costs were taken from the evaluation of State Energy Savings Programme 2016-2017 calculated as unit cost per kt c.e. saved.

New Legislation for Energy Efficiency

As implementation of the NEEAP progresses it may be necessary to develop new or updated legislation for energy efficiency to support the proposed measures. Examples mentioned elsewhere are extending the Building Renovation Strategy Decree to cover the non-residential sectors and extension of the ESCo concept to other sectors. The Government of Belarus has already demonstrated that it is willing to enact legislation to support energy efficiency measures.

Carbon Tax

A Carbon Tax is not recommended in Belarus for the reasons given in Annex E.

3.1.10 Savings arising from horizontal measures

The savings arising from potential new horizontal measures are summarised in the table below.

Table 3-16 Savings arising from horizontal measures

	Sector	Cumulative primary energy savings 2021-2030 [kt c.e.]	Cumulative final energy savings 2021-2030 [kt c.e.]	Renewables 2021-2030 [kt c.e.]	CO_2 reduction [kt]
Extension of the ESCO concept	Horizontal measure	0	448	0	783
Total		**0**	**448**	**0**	**783**

3.1.11 Timing of horizontal measures

Extension of the ESCO concept will be implemented after experience from the ESCO concept in the social sector. Financial incentives for renewables could start in 2021.

Figure 3-4 Timeframe of horizontal measures

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Potential measures											
Extension of the ESCO Concept	2022		●								▶

3.1.12 Financing of horizontal measures

Up to now the horizontal measures have been financed mainly by the state budget and, where appropriate, from local budgets. There has been relatively little IFI involvement in horizontal measures but the Covenant of Mayors programme (see Section 3.3.2) which is funded under the UN's EU4Energy Programme includes some horizontal measures such as awareness raising and education. As mentioned above the EU4Energy Programme completed a project to develop the regulatory conditions for energy performance services (EPC/ESCO) and the draft ESCO regulations have been developed.

In addition EBRD is undertaking a Green City Action Plan (GCAP) in Minsk which is expected to include measures aimed at improving energy efficiency, including horizontal measures.

The World Bank is also active in supporting both renewables and ESCOs and may be interested in supporting such initiatives in Belarus. The IFIs are likely to support further horizontal measures especially for renewables and ESCO activity.

The EU-funded programme "EU4Belarus: A Resource Efficiency Facility for Belarus" will provide technical assistance to identify and develop investment promotion measures to save energy and introduce alternatives for better resource management. The project will provide pilot actions to modernise the municipal infrastructure in the Brest and Grodno regions.

3.1.13 Recommended actions for horizontal measures:

- Take account of investment efficiency of technical measures in the process of preparation of the State Energy Saving Programmes for 2021-2025 and 2026-2030.
- Expand the ESCO concept to public buildings and buildings in industry following successful implementation in the social sector.
- Seek and coordinate further IFI support for horizontal measures.

3.2 Energy efficiency measures in buildings

3.2.1 Current measures

More than 80% of the country's residential stock was built before 1996. Pre-1996 buildings consume, on average, nearly twice as much energy per square meter as buildings constructed in the last four years. Deep thermal retrofits in these older residential and public buildings would result in significant energy savings.

Building thermal protection standards were significantly strengthened in 1993 and updated in 2010. Belarus has established a state system of technical regulations and standards in construction. The specific thermal requirements for individual elements of the building envelope are specified in TKP 45-2.04-43-2006 *"Construction Heat Technology".*

The formal fulfilment of the requirements is checked at the design stage by the relevant authority. However, the practical application does not necessarily reflect the requirements. Installation quality is poor and there is a low guarantee of the authenticity of the construction elements used as designed, although in theory, there is dual control (the state construction supervision and control by the buyer). Insufficient controls mean that the energy efficiency parameters are commonly not achieved in the final building.

Nearly zero-energy buildings in Belarus – there are no new requirements regarding the thermal protection and energy efficiency of buildings and technical installations consuming energy in buildings. The "path" for achieving the nearly zero-energy requirements for buildings has not been prepared yet.

Thermal energy passports for buildings have been introduced, and are included in the package of design and certification/acceptance documents. Legislation and a methodology on energy efficiency of residential buildings has been prepared, and was approved by the Ministry of Architecture in September 2019 – "*Regulation on Improving the Energy Efficiency of Multi-apartment Buildings".*

Calculation of cost optimal levels of minimum energy performance – Belarus has no previous experience in the implementation of this EU initiative and up to now no such calculations in line with the EU Regulation have been carried out. Several building categories (new and existing) would be the subject of the cost optimal level calculation, including single-family dwellings, apartment blocks and multifamily buildings and office buildings.

Specific measures for the Buildings sector under the State Programme on Energy Efficiency and Energy Savings for 2015-20 include:

- Modernisation of thermal networks, optimisation of heat supply schemes, decentralising heat supply with the elimination of long mains;
- Reduction of heat network losses by 10% by 2020, through rehabilitation of at least 4% of the network annually;
- Decommissioning of old equipment;
- Deep thermal renovation of the building envelope for residential buildings;
- Projects with under-floor heating and low-temperature heat from heat pumps and solar thermal heating;
- Reconstruction and modernisation of boilers to include recycling of flue gas heat and water vapour condensation heat of the flue gas;
- Metering requirements and introducing individual automated heat control systems in apartments in buildings of eight[37] apartments or more;

[37] Reduced from 20 apartments in previous legislation

- Heat recovery devices, controlled ventilation and drains;
- Building small CHPs and solar water heaters in hot water supply systems;
- Energy efficient lighting;
- Energy efficiency standards and labelling for appliances;
- Buildings certification by energy efficiency classes;
- Energy data reporting;
- Public awareness and involvement of the population in energy conservation and efficiency in residential complexes.

Legislative Measures include:

- The obligation to ensure the hydraulic balancing of a building's heating system after every intervention in the thermal protection or technical systems:
- To ensure the regulation of heat supply in a building;
- To ensure and maintain the hydraulic balance of hot water distribution systems and to install suitable thermal insulation for heating and hot water distribution:
- The obligation to arrange for periodic checks on heating systems and air-conditioning systems.

Current Energy Efficiency Programmes

National Programmes:
The Department for Energy Efficiency annually develops and approves, upon agreement with the Ministry of Economy, a list of the main energy saving measures financed by the state budget. The list of criteria for the selection of energy-efficient projects for the provision of support from the state budget is agreed upon by the Ministry of Economy and approved by the Decree of the Department of Energy Efficiency dated October 14, 2010 No. 17.

The energy savings in buildings achieved by the State Programme on Energy Efficiency and Energy Savings since 2015 are shown in the table below.

Table 3-17 Energy Savings in buildings from the State Programme on Energy Efficiency and Energy Savings (2015-2017)

	Energy savings [t c.e.]	Energy savings [TJ]	Total investment costs [th. BYN]
Total	**77,768**	**2,279**	**206,666**
- in agriculture	6,379	187	6,944
- in households	149	4	513
- in industry	8,919	261	10,967
- in power industry	296	9	469
- in public sector	57,466	1,684	179,823
- in services	2,096	61	1,603
- in transport	2,463	72	6,343

Source: Evaluation of the State Programme on Energy Efficiency and Energy Savings

Programme of Comfortable Housing and Favourable Environment

This programme effectively sits above the programmes for energy efficiency in buildings. The priority areas are:

- Ensuring the quality and availability of services;
- Modernisation and increase of heat supply efficiency;
- Repair of housing;
- Safe lifts;
- Clean water;
- The management of municipal waste and the use of secondary material resources.

There is a clear connection between this programme and the State Programme for Energy Saving.

Repair of Housing Sub-Programme

The purpose of the Repair of Housing sub-programme is to increase the efficiency and reliability of the housing and utility facilities, to improve the quality of the services provided based on the implementation of social standards and to reduce the costs of their provision. The programme is not aimed specifically at improvements in energy efficiency though these will occur as a by-product of implementing other measures. By the end of 2017, 2,640,000 m^2 of residential buildings had been reconstructed, which is 101.5% of the target. All regions exceeded their individual targets.

The planned and achieved savings from different elements of the sub-programme are shown in the table below.

Table 3-18 Indicators of comfortable housing and favourable environment programme

No.	Indicator	Unit	Planned	Achieved
Overall indicator				
1	Reducing the cost of providing housing and communal services (hereinafter - HCS) to the population in comparable conditions to the previous year	%	5.0	6.1
Target indicators				
1	Reducing claims on the quality of utility services in the previous year	%	1.5	1.8
2	The collection of payments for utility services provided to individuals and legal entities	%	84.0	100.0
3	Replacement of thermal networks	%	4.0	4.0
4	Heat loss reduction in housing and communal services	%	12.0	11.0
5	Modernisation of residential buildings	th. m^2	2,600.0	2,640.0
6	Replacement and modernisation of elevators in residential buildings	pcs	2,896	654
7	Share of consumers with access to drinking water	%	87.1	87.3
8	Collection of secondary material resources	kt	751.7	653.8

Improvements in the thermal performance of existing buildings, especially in the public sector, have contributed most to reductions in final energy consumption.

The energy efficiency of buildings has been boosted in particular by the greater funding available to improve the thermal performance of multi-family buildings via financial resources provided to the State Housing Development Fund from the State and regional budgets.

Annual Inspections of Boilers and Heat Networks

Directive 2002/91 / EC on the energy performance of buildings has introduced the obligation to test all boilers in non-manufacturing plants with an effective rated power of 20 kW or more. As a result, annual inspections of boilers and heating networks are carried out in Belarus before the start of the heating season.

Reports on inspections of boilers and heat distribution systems are monitored by the Department of Energy Efficiency. Approximately 12,000 inspections of boilers and distributions systems are carried out in the building sector, of which approximately 3% of inspections detect some shortcomings. These have to be repaired within 2 weeks.

There are no mandatory regular inspections of air-conditioning systems in buildings. Introducing such a scheme for central a/c systems above a certain size in public and commercial buildings is a potential measure for the NEEAP, probably as part of the next State Energy Saving Programme.

3.2.2 Building renovation strategy

A national Building Renovation Strategy (BRS) has been under development since April 2018, but later it was decided to transform it into the Decree on Energy Efficiency in the Residential sector. This decree was approved on 4th September 2019.

The Decree prescribes measures to increase the comfort of living in multi-family residential buildings, improve the quality of the housing stock and improve the efficiency of heat energy use in multi-apartment buildings. The Decree estimates that up to 50% of the funds that will be allocated for thermal modernisation or other energy-efficient measures in residential building will be co-financed by the state. The decision to implement energy-efficient measures has to be adopted by a general assembly of owners of residential and non-residential premises, or members of the organisation of developers in a multi-apartment building.

Sources of financing for energy efficiency measures will mainly be the funds of owners of residential and/or non-residential premises of an apartment building. It is expected that the following financial sources can contribute to the total renovation budget:

- local budget funds from the privatization of residential premises that are under the economic or operational management of local executive and administrative bodies;
- local budget funds allocated for the overhaul of the housing stock;
- local innovation funds;
- loans from financial and credit organizations, including IFIs, organised by local executive and regulatory bodies;
- dedicated cumulative accounts of citizens for reconstruction of residential buildings;
- other sources of financing not prohibited by law.

The proposed new SuperESCO could also provide funding for building renovations where these are linked to improving energy efficiency.

Since the new Decree will include only the residential sector there is a need to develop BRS that covers all types of buildings, both public and private, in accordance with principles the EU Energy Performance in Buildings Directive. The BRS will need to take into account the actions already planned in the Programme of Comfortable Housing and Favourable Environment and the Repair of Housing Sub-Programme such that the BRS provides incremental effort in addition to these. Further details on a proposed BRS are included in Annex A.

Calculation of energy savings, CO_2 savings and costs are described chapter 3.3.2.

3.2.3 Additional measures addressing energy efficiency in buildings and appliances

Other measures that are being implemented in the EU to improve energy efficiency in buildings and appliances include the following.

Nearly Zero Energy Buildings (nZEB)

As the minimum energy performance requirements for new buildings have not yet been tightened to the low-energy or nearly zero-energy standard, there is a potential for new buildings to be built to the nZEB standard in Belarus.

The general definition of nearly-zero energy building (nZEB) is a building with very high-energy performance, where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby. Achieving nearly zero-energy demands in new buildings represents an ambitious target of increasing the energy performance of new buildings and simultaneously, it is a target fundamentally affecting public and private life in society. It will require effective planning of investments, objective requirements to secure adequate financial resources, resolution of the necessary forms of financial support, but also, in particular, creation of the legal and technical conditions and appropriate time for design and implementation preparations.

Further details of nZEB are provided in Annex B.

Electrical Appliances and Lighting

Energy efficiency measures in the appliances sector focus in particular on:

- The replacement of white goods;
- Energy-efficient lighting (particularly LEDs);
- The replacement of equipment in households and offices.

The replacement of white goods has resulted in significant energy savings due to the tightening of minimum technical requirements by the State Standardization Commission within the scope of established eco-design and labelling legislation. In addition consumer awareness campaigns were run to improve the appeal of more efficient appliances.

The biggest change occurred in the use of lighting, with LED lighting becoming the standard for virtually all households. Between 2010 and 2012, LED lights were viewed as ‘experimental’ and their reliability and service life were unknown. After 2015, households started to treat them as a fashionable solution, and halogen and fluorescent lights are being replaced across the board.

The replacement of white goods, the installation of energy-saving lighting and the tightening of minimum technical requirements are expected to continue in the appliances sector. The Ministry of Antimonopoly Regulation and Trade, the State Committee of Standardisation and the Department of Energy Efficiency are planning to arrange the monitoring of further types of appliances in the white goods sector (i.e. not only fridges and freezers, but also washing machines, vacuum cleaners, dishwashers, and other appliances).

On the regulatory front the forthcoming Technical Regulation of the Eurasian Economic Union (EEU) *"On the requirements for energy efficiency of energy-using devices"* will also have a positive effect on energy consumption in electrical appliances. This technical regulation establishes mandatory requirements for the performance of energy-using devices in terms of their energy efficiency and labelling in the territory of the EEU.

3.2.4 Savings arising from measures in buildings

Continual revision to building regulations will have a significant influence in reducing average energy demand in buildings up to 2030. Delivery of a deep level of retrofit measures will also increase the number of installer jobs in Belarus. Ongoing energy efficiency improvements and broad scale roll-out of nZEB technologies could sustain high levels of employment over the period of implementation. Actions that reduce Belarus’ reliance on imported fossil fuels will have significant security of supply benefits.

The savings arising from potential new measures in buildings are summarised in the table below.

Table 3-19 Savings arising from new potential measures in buildings

	Sector	Cumulative primary energy savings 2021-2030 [kt c.e.]	Cumulative final energy savings 2021-2030 [kt c.e.]	Renewables 2021-2030 [kt c.e.]	CO_2 reduction [kt]
Building Renovation Strategy	Buildings	0	1,021	0	860
Nearly Zero Energy Buildings (nZEB)	Buildings	0	545	185	1,076
Total		0	1,566	185	1,936

3.2.5 Timing of measures in buildings

This Buildings Renovation Strategy for the residential sector was approved in September 2019. The strategy covering all types of buildings should be developed and approved before 2021. Given the long term nature of the renovation process, the strategy needs to be seen as a living document that is regularly reviewed and updated. The period to 2025 will be a steep learning curve. It is a period in which policy packages will need to be tried and tested, and for learning and sharing of experience across the country. Building owners will need to be sensitised to the importance of building renovation, while the supply chain will need to gear up to be in a position to deliver the increased activity levels.

Nearly Zero Energy Buildings need a longer preparatory phase, therefore the estimated start year is 2025 (see Annex B for a Road map to nZEB). Large scale roll-out of nZEB technologies will enable a shift from fossil based energy sources to a sector based largely on renewable energy sources and highly efficient micro-generation technologies.

Figure 3-5 Timeframe of measures in buildings

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Potential measures											
Building Renovation Strategy	2021	●	→	→	→	→	→	→	→	→	▶
Nearly Zero Energy Buildings (nZEB)	2025					●	→	→	→	→	▶

3.2.6 Financing of energy efficiency measures in buildings

Significant investment will be required to realise the full potential available, however over the lifetime of technologies installed, substantial net financial benefits flowing from energy savings will also be realised. Financing for buildings in the social sector has mainly come from the State budget whilst municipalities and ministries have financed energy efficiency improvements in their buildings from their own funds. Financing of improvements in the residential has mainly come from own funds (or commercial loans) and up to 50% of the cost will be co-financed by the state.

The IFIs have been particularly active in the buildings and the closely associated heat/energy supply sector. Projects include the following:

World Bank

Implemented – buildings / (renewable) energy generation

- *Modernisation of Social Sector Infrastructure in Belarus (2002–2008)* – Included measures for the modernisation of lighting and heating systems, thermal modernisation of building envelopes and replacement of windows, rehabilitation of boiler houses and optimisation of the heat supply of social sector facilities - *USD 22.6 M*
- *Rehabilitation of Regions Affected by the Accident at Chernobyl NPP (2007-2013)* - rehabilitation of 13 boiler houses; putting into operation of 8 cogeneration plants; establishment of energy efficient lighting systems at 224 facilities; thermal rehabilitation of building envelopes and installation of energy efficient multiple-glazing windows at 106 facilities – *USD 50M.*
- *Improvement of Energy Efficiency in the Republic of Belarus (2009-2014)* - refurbishment six energy facilities by developing modern energy efficient CHPs, including four boiler houses in the housing and utilities sector and two major energy facilities for RUE Minskenergo and RUE Mogilevenergo - *USD 125M*
- *Improvement of Energy Efficiency of Residential Buildings (2011–2015)* – development of regulations, standards and incentives for the construction of energy efficient buildings and housing rehabilitation, training and pilot projects for energy efficient residential buildings.
- *Enhancing Energy Efficiency in the Republic of Belarus (2013-17)* - reconstruction and conversion of 6 boiler houses into mini-cogeneration plants (CHPs) and the modernization of two heat and power plants – *USD 215M.*

Under implementation – buildings / (renewable) energy generation

- *Belarus Biomass District Heating Project (2014-2021)* - construction of 10 boiler houses and 3 mini-CHPs fired on wood fuel in the housing and communal services organizations together with the reconstruction of seven additional facilities – *USD 90 M.*
- The current *Biomass DH project* (07/2014 – 12/2019) has been extended until 2020 (adding 7 new sites - Kobryn, Buda-Koshelevo, Borovlyany, Novogrudok, Vorontsy, Schuchin, Stolin).
- *Sustainable energy scale-up project (2019-2025).* Investment cost to be covered by the World Bank and the European Investment Bank (in total $200M): $140M – 35 DH systems to be equipped with smaller biomass boiler houses; $60M – thermal renovation of residential buildings (plus co-financing of $60M from Oblast budget in Grodno and Mogilev).

EBRD

Pipeline – residential buildings

- *Energy efficiency investments for residential buildings in the City of Minsk* - total project costs are estimated at *EUR 20.0M.*

UNDP/GEF

Implemented - buildings

- *Improving Energy Efficiency in Residential Buildings in Belarus (2012-2018)* – energy saving policy in the housing sector, construction of three pilot energy efficient multi-apartments in Minsk, Hrodna and Mahilou – *USD 4.9M* (including GEF funding).
- *Developing an Integrated Approach to a Stepped-Up Energy Saving Programme (2013–2017)* – enhancement of efficient use of energy resources at the local level through application of energy-saving technologies and measures in educational buildings – USD 2.0 M.

Buildings projects are also included in the **UN ECE - EU4Energy** Covenant of Mayors programme as outlined in Section 3.1.12.

Financing for new measures in the Buildings sector will continue to come via the State Energy Saving Programme and municipal budgets but the IFIs are also likely to play a significant role.

3.2.7 Recommended actions for measures in buildings:

- Further develop the Building Renovation Strategy (BRS) in order to cover all types of buildings to supplement the Decree on Energy Efficiency in the Residential sector that has been adopted in September 2019.
- Establish a national Nearly Zero Energy Building programme and actively promote market uptake of such buildings through policies and programmes to increase public awareness.

3.3 Energy efficiency measures in public bodies

3.3.1 Central government buildings

Although the central government buildings in Belarus are maintained to a relatively high level compared with many other buildings, further energy savings are possible from measures such as improving heating control systems, installing LED lighting and the use of small-scale renewables.

The total floor area of central governmental buildings in Belarus is more than 400,000 m². There is currently no central inventory of floor areas and energy performance in individual buildings in the central government estate.

According to the EU Directive on energy efficiency, each Member State should ensure that 1% of the total floor area of heated and/or cooled buildings owned and occupied by central bodies of State administration is renovated each year to meet at least the minimum energy performance requirements for buildings. There is no obligation for Belarus to match this target but if it aims to do so then it would be necessary to renovate 4,000 m^2 of buildings floor area each year.

This target may also be pursued by an alternative approach (Article 5(6) of the Directive) to achieve the same level of energy savings as the basic approach.

A potential NEEAP measure is to establish a system whereby a Ministry or Department maintains a list of relevant governmental buildings, which it publishes on its website and updates each year. The list would state the total floor area of each building and its energy performance.

3.3.2 Buildings of other public bodies

The public building stock, like the residential building stock, consists mainly of pre-1996 buildings with poor energy performance - more than 90% of public buildings. These include around 95% of kindergartens and secondary schools, nearly 100% of clinics, and 98% of administrative buildings. Thermal retrofits in these buildings could result in substantial energy savings.

Recently constructed public buildings have substantially better energy performance than those built before 1996. According to the World Bank assessment, around 2,479 secondary schools, 1,125 urban and 1,353 rural schools, 2,236 kindergartens totalling some 6,633,000 m^2 do not meet modern energy performance requirements implying that 66,330 m^2 should be renovated each year.

The Government of Belarus began work to improve the energy efficiency of the public building stock many years ago[38]. The work has included close collaboration with the IFIs, including projects implemented jointly with the Energy Efficiency Department, Ministry of Energy and Oblast Executive Committees.

Educational Buildings

In 2018, Belarus had 7,295 educational institutions, including preschool, general secondary, vocational technical, special secondary and higher education establishments, attended by 1,624,500 students. Assuming that the educational institution is located in at least one building, the above number can be interpreted as the total number of educational buildings as a first approximation. As of 2018, there were 3,035 secondary schools and 3,803 kindergartens in Belarus. Since 2000, new construction of kindergartens has provided space for an additional 991 kindergarten students each year, on average. Over the same period, new secondary schools provided space for an additional 6,408 students per year, on average.

There have been an estimated 167 new secondary schools and 95 new kindergartens built since 1996. Kindergartens make up 28% of all educational buildings, while secondary schools make up another 33%. Roughly 55% of secondary schools are in rural areas, and 45% are in urban areas.

Health Buildings

The two relevant types of health care organisations are inpatient hospitals, where patients can stay overnight, and outpatient polyclinics, where patients come only for day visits. As of 2017, there were 622 inpatient hospitals in Belarus and 2,196 outpatient polyclinics. The Ministry of Health has designated about 10 percent of healthcare buildings for top priority renovation.

It can be assumed that the number of outpatient polyclinics organisations equals the number of polyclinic buildings. However, inpatient hospitals often occupy several buildings, and it is not possible to accurately estimate the total number of buildings they occupy.

Heat consumption in outpatient polyclinic buildings differs according to the year of construction and building materials used. Outpatient polyclinics built before 1996 have substantially higher heat consumption than those built in later periods, and therefore have considerable energy savings potential.

Administrative Buildings

There are no publicly available statistical data on administrative buildings in Belarus. The total area of administrative buildings can be estimated based on the number of administrative workers in various economic sectors as well as design standards for selected administrative buildings. Analysis of building design documentation suggests an area of 8.15 m^2 per worker. It can be estimated that this “worker area” per building is about 65 percent of the total heated area for each building. These estimates result in a total heated area for administrative buildings of around 9,619,000 m^2.

It is estimated that about 98 percent of all administrative heated area was constructed before 1996. This leaves a total of 9,485,000 m^2 of heated area in need of thermal retrofit but these would not be covered by the 1% target since they are not government or public buildings. However, this still leaves around 70,000 m^2 in public buildings that should be renovated each year.

[38] Council of Ministers' „Decree # 1820 on Additional Measures for Efficient Use of Fuel and Energy Resources“ in 2003, to equip all public buildings with heat and water meters and systems of heat energy regulation.

In the coming period, there will be continued support for improvements in the thermal performance of public buildings from existing support mechanisms (in particular the State Program "Energy Saving") and international funds[39], where appropriate in combination with an energy services mechanism (EPC/ESCO).

The Department for Energy Efficiency annually develops and approves a list of the main energy saving measures financed by the state budget. The list of criteria for the selection of energy-efficient projects for the provision of state support from the State budget is agreed upon by the Ministry of Economy and approved by the Decree of the Department of Energy Efficiency dated October 14, 2010 No. 17. The evaluation includes 12 criteria, which take into account the main energy saving priorities.

According to the reporting data, for the implementation of the general complex of energy-saving measures of the State Program, 1,202 mln. BYN were allocated from all sources of financing in 2017, which amounted to 63.1 percent of the plan. The main source of financing was the organisation’s own funds (64.8% of the total). Bank credit resources and local budgets amounted to 12.0% and 13%, respectively. The State budget allocated for the financing of the State Program "Energy Saving", amounted to 0.9 percent of the total expenditure.

Investments in the implementation of energy efficiency measures in the public sector will be reflected in lower public spending on energy costs. To maximise the effectiveness of energy efficiency improvements the following items need to be considered:

- Secure financing for the renovation of the buildings of the State administration and organisations within their control. Sufficient resources need to be secured for deep refurbishments, not just for partial renovations where there is serious disrepair.
- Actively promote the principles of energy efficiency in public procurement provided that this is cost-effective – especially in the letting of buildings, the procurement of leases of non-residential premises, vehicles, and building technical systems for heating and air-conditioning. Make subsequent arrangements for subsequent monitoring of savings.
- Support the optimisation of energy consumption for central and local government entities.

The most important energy efficiency measures in the public sector (including public buildings) include:

- Support programmes and other financial stimuli – the support of building renovation from national resources (State and regional funds) and other resources (the IFI initiatives and others).
- Legislative measures –to ensure the regulation of heat supply in a building, to ensure and maintain the balance of space heating distribution systems, to install suitable thermal insulation for heating and hot water distribution systems, and the obligation to arrange for periodic checks on heating systems.
- Other support measures in the buildings sector including information campaigns.
- Upgrading of public lighting.

Many of these measures are already included in the State Programme on Energy Efficiency and Energy Savings but need to be enhanced if the revised 2030 target is to be achieved as described in Section 2.1.

Sustainable Energy and Climate Action Plans (SECAP)

Currently, 55 Belarusian cities have joined the Covenant of Mayors programme and are preparing SECAPs for 2021-2030. The full list is available on http://com-east.eu.

The Covenant of Mayors is a European Initiative aimed at local and regional authorities that voluntarily commit themselves to improving energy efficiency and using renewable energy sources on the territory they manage. The Covenant signatories commit themselves to meet and exceed the EU target of reducing CO_2 emissions by 20% by 2020 and by 30% by 2030 compared to the baseline year. The City is free to choose the base year against which the target shall be compared to. Besides reduction of emissions of greenhouse gases through mitigation measures, the Cities commit to implementing adaptation measures aiming at prevention of damage caused by existing climate change risks.

[39] Post-Chernobyl Recovery Project (2006-2013)– USD 80M investment and Social Infrastructure Retrofitting Project (2001-2010), USD 37.6 M investment, both implemented by the World Bank

It follows from the Covenant, its supporting materials and examples from other cities that for successful application of the Covenant of Mayors programme, cities should implement a series of actions that have probably not previously been undertaken, including:

- To set (calculate) a possible target for 2020 and 2030 reduction in CO_2 emissions in the City by implementing a SECAP in the areas of activities related with the mandate of the city.
- To prepare a baseline emission inventory as a basis for the SECAP.
- To develop the SECAP in line with the European Commission methodologies.
- To ratify this commitment and SECAP through City procedures.
- To adapt the administrative structure of the City and allocate (reallocate) human resources so that the needed actions can be taken.
- After submitting the SECAP, an implementation report is to be presented at least every two years for the purpose of evaluation, monitoring and verification (there is a need for the City to have mechanisms for monitoring and evaluating the SECAP performance – in necessary formats).
- To organise Energy Days or Covenant of Mayors Signatory Days in cooperation with the European Commission and other stakeholders, thereby enabling the citizens to benefit directly from the opportunities resulting from more intelligent energy use.
- To inform local media about the progress of the SECAP on a regular basis – to set monitoring the performance of activities and projects to allow submitting the reports.
- To disseminate the message of the Covenant in appropriate fora and, above all, encourage other mayors to join the Covenant.

<u>Project Examples</u>

Examples of projects implemented under the Covenant of Mayors Programme include the following:

Five Belarusian cities – Braslaŭ, Čausy, Biaroza, Oshmyany and Polack – have been awarded grants under the Covenant of Mayors programme and received more than €4 million to implement the following projects:

- Braslaŭ district (2016-2018) – the first climate-neutral municipality in Belarus. As part of the project biomass (wood) boilers were installed, district heating was replaced by individual boilers, solar collectors, heat exchangers and occupancy sensors were installed in public buildings, and 5% of urban street lamps were replaced by LED lights. Total Project Budget: €735,140.

- Energy efficient modernisation of public lightning in the city of Polack (2015-2018). 16 central streets are to install new LED lighting, more than 40 historical sites have decorative LED lighting, and around 70 intelligent lighting control units were installed. Total Project Budget: €1,630,521.

- System of automation for energy and water in the city of Čavusy (2015-ongoing) - the city is implementing a major modernisation including the launch of a smart system for monitoring and management of water supply, the installation of biosensors, the upgrading of the central sewerage system, and the implementation of an automated system for commercial accounting of electric power consumption. Total Project Budget: €595,269.

In 2018 five Belarusian cities (Klichev, Krasnopolye, Bykhov, Mosty, and Vitebsk) received NGO assistance to develop SECAPs. Strategies have been prepared for measures, which will help reduce greenhouse gas emissions by 30% by 2030 and reduce effects of climate change. These include measures to improve the energy effectiveness of buildings, the use of alternative sources of energy and reconstruction of storm drains to eliminate the risk of flooding during extreme precipitation.

These examples serve to emphasise the role that municipalities can play in achieving the NEEAP targets.

Calculation methodology: Energy saving, CO_2 saving and costs in the period of 2021-2030 are calculated based on the SECAP in Vitebsk (a city with 340,000 inhabitants) and the final energy consumption of the industry sector in 2017. The following assumptions were made:

- All cities above 20,000 inhabitants will develop a SECAP and implement 70 % of technical measures described in the SECAP.
- To avoid double counting of energy saving, CO_2 saving and costs, some of the technical measures were excluded from the calculation (insulation of buildings, modernisation of lighting, reduction of heat losses in heating pipelines).

By 2030, 676 kt c.e could be achieved in final energy savings and 43 kt. c.e. could be achieved in primary energy savings.

Given the requirement in Article 5 of EED for national governments to demonstrate an exemplary role through renovation of the central government estate annually, the State administration needs to prioritise this sector in the National Renovation Strategy. At the same time, the national goal should be to apply a similar level of ambition throughout the rest of the public sector, both regionally and locally, including to the significant property portfolios such as health, defence, education, public administration and leisure services.

Final energy consumption in public buildings for heating: 361 kt c.e.

The energy saving potential: 361 x 0.55 = 198 kt c.e.

2% of the potential will be achieved annually: 198 x 0.02 = 3.97 kt c.e. Cumulative energy savings to 2030 will be 179 kt c.e. as illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0,0	4,0	7,9	11,9	15,9	19,8	23,8	27,8	31,7	35,7	**179**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-20 Sustainable Energy and Climate Action Plans (SECAP) – energy savings, production of renewables, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative final energy savings	676 kt c.e.
Cumulative primary energy savings	43 kt c.e.
Renewable energy production	214 kt c.e.
Cumulative CO_2 savings	1,593 kt c.e.
Investment costs	976 mln. BYN

Investments costs of technical measures were taken from the SECAP in Vitebsk.

Potential measures

Future measures in the buildings sector are essentially a continuation of existing programmes and should therefore include:

- Deep thermal renovation of the building envelope for residential buildings;
- Increased use of small-scale urban renewables including solar PV, solar thermal, heat pumps, and biomass boilers for apartment blocks and public buildings;
- Replacement of individual gas boilers with modern condensing boilers;
- Improve metering and introducing individual automated heat control systems in individual apartments;
- Heat recovery devices, controlled ventilation;
- Small CHPs and solar water heaters in hot water supply systems;
- Energy efficient lighting;
- Energy efficiency standards and labelling for appliances;
- Buildings certification by energy efficiency classes;
- Energy data reporting;
- Public awareness and involvement of the population in energy conservation and efficiency in residential complexes.

The required measures are well known and use established technologies. The main barrier is financing of the improvements.

Central database of energy performance in public buildings

Currently there is no central database of public buildings providing floor areas and energy performance. The development of such a database would enable the compilation of data on energy use per m^2 and would so help to direct improvement interventions at the worst performing buildings (and where appropriate, the building occupants). This measure does not bring any energy savings itself, but is an essential part of the Building Renovation Strategy described below.

Building Renovation Strategy

As part of their NEEAP (EED Article 4) EU Member States are required to develop a Building Renovation Strategy (BRS) which sets out a long term vision for mobilising investment in renovation of the existing building stock. This will include:

- Identifying key stakeholders and information sources;
- Technical and Economic Appraisal;
- Policy Appraisal;
- Consulting on the Renovation Strategy;
- Finalisation, Publication and Delivery.

Development of a BRS would be beneficial in Belarus and would supplement the activities already ongoing and planned under the State Energy Saving Programme, the Programme of Comfortable Housing and Favourable Environment, and the Repair of Housing Sub-Programme.

Calculation methodology:

Energy savings arising from measures in buildings were calculated by the LEAP model using the following methodology

Residential buildings were categorised in two groups:

- By location
    - Urban houses
    - Rural house
- By energy insulation standard
    - Buildings built before 1993
    - Buildings built in the period 1993 – 2009
    - Buildings built after 2009
    - Refurbished buildings
    - Near zero energy buildings (nZEB)

Historical data for the above categories came from statistics of the construction sector. The projection of future development comes from:

- Projection of population growth;
- Projection of number of persons per dwelling based on extrapolation of the current trend. It reflects the trend that the number of persons in one dwelling is gradually decreasing;
- Extrapolation of the trend in population moving from rural areas into cities.

The projection takes into consideration also the average demolition rate. This was derived from the difference of construction of new buildings and statistics of total occupied buildings. The demolition rate for rural buildings is quite high because it reflects the decrease of population in rural areas.

The scenario business as usual (BAU) treats all new construction at the standard of buildings built after 2009.

Refurbishment of existing buildings (assuming that the priority will be buildings built before 1993) uses the assumption that the annual share of refurbished buildings will reach 1% of the total buildings stock.

Construction of nZEBs (supposing that part of the new construction will follow the nZEB standard instead of the standard of buildings built after 2009) assumes 100 % share of nZEBs on the total annual construction in 2025.

Energy consumption of households was split into three segments:

- Consumption depending on number of dwellings – energy consumption for cooking, electricity consumption for lighting and electricity consumption of appliances. Energy consumption of this segment was calculated in terms of final energy. Assumptions for energy saving measures modelling:
    - Refurbished houses – refurbishment will have no impact on this part of energy consumption
    - nZEBs – part of electricity consumption will be covered by photovoltaic panels.
- Consumption depending on number of persons – energy consumption for water heating. Energy consumption of this segment is calculated in terms of useful energy taking efficiencies of boilers into consideration. Assumptions for energy saving measures modelling:
    - Refurbished houses – the boilers will be replaced with more efficient ones; no new boilers using peat will be installed
    - nZEBs - the boilers will be replaced with more efficient ones or with heat pumps; no new boilers using peat will be installed; part of energy consumption for water heating will be covered by solar panels.
- Consumption depending on the size of flats measured in m^2 – energy consumption for space heating. Energy consumption of this segment is also calculated in terms of useful energy. Assumptions for energy saving measures modelling:
    - Refurbished houses – the buildings will undergo a complex refurbishment leading to better thermal insulation, the boilers will be replaced with more efficient ones, no new boilers using peat will be installed
    - nZEBs – the buildings will be built in the nZEB standard (insulation, efficiency of boilers), no new boilers using peat will be installed, part of energy consumption for space heating will be covered by heat pumps and solar panels.

The following table shows the used shares of energy consumption in individual types of buildings:

Table 3-21 Shares of energy consumption in individual types of buildings

	Urban houses	Rural houses
Buildings built before 1993	100%	100%
Buildings built in the period 1993 – 2009	65%	65%
Buildings built after 2009	35%	35%
Refurbished buildings	55%	55%
Near zero energy buildings (nZEB)	28%	26%

The breakdown of energy consumption by energy uses and energy carriers is based on the results of energy survey of households from 2015.[40] and official energy balances (Belstat).

Services

Since there is no information on energy consumption breakdown by energy uses, the modelling of the service sector is simplified by using energy types and final energy only. The projection of energy consumption stems from the projected development of value added of the sector. Only three options are defined for the service sector:

- Old buildings – no changes in energy intensity are assumed;
- Refurbished buildings – the resulting energy consumption reaches 65% of that of old buildings (i.e. 35% savings);
- nZEBs – expected energy consumption reaches 55% of that of old buildings (45% savings); a proportion of electricity and heat consumption is covered by solar installations.

[40] http://www.belstat.gov.by/upload-belstat/upload-belstat-pdf/oficial_statistika/Potreblenie_energii_v_dom_hoz.pdf

The cumulative energy savings to 2030 are shown below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
16.7	34.1	52.0	70.6	89.7	109.5	130.0	151.0	172.6	194.7	**1,021**

Table 3-22 Building Renovation Strategy – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	1,021 kt c.e.
Cumulative CO_2 savings	860 kt
Investment costs	2,639 mln. BYN

The energy consumption of services by energy carriers comes from official energy balances. The energy intensity improvements were estimated using the experience from the Czech Republic.

Investment costs were calculated using statistics of refurbished buildings under the BELSEFF facility project initiated by the EBRD. The specific investment costs are 14.2 mln BYN/kt c.e.

Nearly Zero Energy Buildings (nZEB)

Ambitious requirements for energy performance in new buildings are an effective way to foster innovation and achieve a significant reduction of energy use (and GHG), contributing to the energy independence of the country. In order to start up and stimulate increasing numbers of newly constructed energy efficient buildings, implementation of Article 9 of the Energy Performance of Buildings Directive (EPBD, 2010/31/EC) would be beneficial for Belarus.

The almost zero or very small quantity of energy required in order to supply these buildings must be secured with effective thermal protection and a high proportion of energy from urban renewable sources in the buildings or their proximity. To achieve the nZEB parameters it is necessary to proceed from the acceptance and determination of three interrelated criteria:

- Reduction of specific heat demand for heating to a minimum. Such a criterion requires a quality design of the building's envelope construction and assumes the use of solar and internal gains.
- Reduction of primary energy consumption for heating, cooling, ventilation, domestic hot water and lighting. The criterion already requires the interconnection of construction and technology. It has an impact on the reduction of the expected consumption of fuels and other forms of energy and better describes the environmental impact of using the building.
- Significant coverage of the overall primary energy demands with urban renewable energy sources. Supply of energy from renewables found in the building or its proximity should provide at least a 50 % reduction of primary energy.

The calculation methodology is as described for the Building Renovation Strategy.

The cumulative energy savings to 2030 are shown below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0	0	0	0	26.9	53.2	79.0	104.2	128.7	152.6	**545**

Table 3-23 Nearly Zero Energy Buildings (nZEB) – energy savings, production of renewables, CO_2 savings and costs

Period of implementation	2025-2030
Cumulative energy savings	545 kt c.e.
Renewables energy production	185 kt c.e.
Cumulative CO_2 savings	1,076 kt
Investment costs	2,518 mln. BYN

Investments costs are considered as 15% additional costs compared with conventional costs of a new building (500 000 BYN per family house) to achieve the Nearly Zero Energy Buildings standard.

3.3.3 Purchasing by public bodies

The EU Directive requires that when an energy-related product is to be procured, the contracting authority establishes requirements only for an energy-related product that complies with highest-performance criteria and belongs to the highest energy efficiency class.

The obligation to procure products that comply with the highest-performance criteria and belong to the highest energy efficiency class does not necessarily apply to contracts where the estimated value is lower than a set financial limit or if the procurement of such a product is not appropriate in view of cost-effectiveness, is not economically viable for the contracting authority, is not technically appropriate, or does not facilitate competition.

In the evaluation of bids for products and services in the public sector in Belarus, guidance to the responsible body suggests that it should take account of the product life-cycle costs and procure products that comply with the highest performance criteria and belong to the highest energy efficiency class, especially in relation to:

- Heat production facilities;
- Air-conditioning and ventilation facilities;
- Computer technology;
- Interior lighting.

Potential measures

The "Exemplary State" process

The "Exemplary State" process sets three goals:

- To encourage the increase of sustainable methods of production and consumption;
- To implement Eco responsibility measures in order to reduce both energy wastage and greenhouse gas emissions;
- To reinforce the social responsibility of the State.

The "Exemplary State" process involves implementing plans for an exemplary administration. These plans are based on instructions set by the competent State Authorities. Examples of these instructions are:

- New office equipment must be TCO Certified[41], which ensures minimal environmental impact for the product and its production during the whole life cycle;
- Print cartridges must be recycled;
- Paper consumption must be reduced by a specified amount;
- Purchased items must have Eco-labels;
- Selective waste sorting must be undertaken;
- Procurement of energy efficient vehicles;
- Drivers must be trained in Eco-driving;
- Energy audits should be carried out in all public buildings.

An incentive mechanism could be implemented to stimulate the behaviour change required for sustainable development. It would consist in setting up a "frozen virtual fund" dedicated to public procurement, and which would provide a refund depending on the Eco-responsibility results. The funds would be awarded to the best-performing state department at the expense of less good performers.

New legislation[42] has recently (June 2019) been passed on public procurement. It should be relatively straightforward to add an addendum to this legislation dealing with energy-related products and services.

Calculation methodology: The implementation of the "Exemplary Role" measure resulted in a reduction of 5% of the energy consumption of the public buildings occupied by state services in the Czech Republic (NEEAP, 2017).

[41] Conformity with TCO Certified's standard is verified by an independent organization. See www.tcocertified.com

[42] Decree of the Council of Ministers of the Republic of Belarus of June 15, 2019 No. 395 "On the implementation of the Law of the Republic of Belarus on public procurement of goods (works, services)"

About 20% of the final energy consumption in the public sector is affected by this measure. With the promotion of this measure, Belarus could achieve 66 kt c.e. of energy savings by 2030. The buildings affected by the implementation of this measure are public offices and ministries, health and social buildings, educational and cultural buildings. The calculation methodology is based on the final *electricity* consumption in the public sector of Belarus in 2017 because State Authorities will mainly buy new more efficient office equipment consuming electricity. Exemplary role of the state is a cost-free measure (the inclusion of an energy efficiency parameter when purchasing new appliances is a cost-free measure).

Final electricity consumption in public sector: 120 kt c.e.

Final electricity consumption in public sector affected by the measure: 120 x 0.2 = 24 kt c.e.

5% of annual electricity savings: 24 x 0.05 = 1.2 kt c.e.

Cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	**66**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-24 The “Exemplary State” process – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	66 kt c.e.
Cumulative CO_2 savings	240 kt
Investment costs	0 mln. BYN

3.3.4 Savings arising from measures in central government and other public bodies

For existing government buildings, an energy-efficiency refurbishment roadmap needs to be developed. The aim should be to create a nearly carbon-neutral stock of existing buildings by 2050. Already by 2030, a reduction of the final energy consumption for heating by 20 % should be achieved. To this end, specific buildings are to be improved in regard to energy efficiency to such an extent that the nearly zero-energy standard is met.

The savings arising from measures in central government and other public bodies are summarised in the following table.

Table 3-25 Savings arising from measures in central government and other public bodies

	Cumulative primary energy savings 2021-2030 [kt c.e.]	**Cumulative final energy savings 2021-2030 [kt c.e.]**	**Renewables 2021-2030 [kt c.e.]**	**CO_2 reduction [kt]**
Sustainable Energy and Climate Action Plan (SECAP)	43	676	214	1,593
Building Renovation Strategy	0	1,021	0	860
Nearly Zero Energy Buildings (nZEB)	0	545	185	1,076
The “Exemplary State” process	0	66	0	240
Total	**43**	**2,308**	**399**	**3,768**

3.3.5 Timing of measures in public bodies

Potential new measures in public bodies could start in 2021. 44 cities are preparing SECAPs for 2021-2030. A Buildings Renovation Strategy covering all types of buildings should be developed and approved before 2021. The "Exemplary State" process should start in 2021 as no long preparation period is needed. "Nearly Zero Energy Buildings" could start in 2025 after a preparatory period from 2020-2025.

Figure 3-6 Timeframe of measures in public bodies

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Potential measures											
Sustainable Energy and Climate Action Plan (SECAP)	2021	●									►
Building Renovation Strategy	2021	●									►
Nearly Zero Energy Buildings (nZEB)	2025					●					►
The "Exemplary State" process	2021	●									►

3.3.6 Financing of energy efficiency measures in public bodies

Up to now most of the financing for energy efficiency measures in public bodies has come from their own funds, though several of the IFI projects outlined in Section 3.3.5 also include public bodies. In the future, energy performance contracting (EPC) is also a potential source of funds for this sector.

Energy services and EPC is in its infancy and is not yet developed Belarus. Although there is great potential for EPC in all the sectors of the economy, the energy saving potential and the technical and business/financial risks related to the project need to be evaluated in all cases.

According to the State Programme on Energy Efficiency and Energy Savings the biggest energy savings potential is in electricity consumption and in the industrial sector, though the public sector also has significant technical potential and has been a major focus for EPC schemes in other countries. EPC in this sector could overcome the difficulties of allocating budgetary funds to finance energy efficiency measures. There is, however, a need for additional energy management expertise at the municipal level and in the public sector generally.

The residential sector with 28.1% of total final energy consumption should also be considered as a target for EPC. The main limiting factor for the development of performance contracts in this sector is the subsidised electricity and heat tariffs, which reduce the potential returns for the EPC contractor.

Future financing in public bodies will continue to come from the organisations own funds but the IFIs may also support projects with the right profile for lending.

3.3.7 Recommended actions for measures in public bodies:

- Cooperate with the Covenant of Mayors East and their signatories in developing SECAPs and monitoring reports;
- Establish an regularly updated information system of all governmental and public buildings containing the total floor area of each building and its energy performance;
- Initiate the "Exemplary State" process. The first step could be including energy efficiency parameters in the public procurement of office equipment.

3.4 Energy efficiency measures in industry

3.4.1 Main policy measures addressing energy efficiency in industry

The Department of Energy Efficiency monitors energy savings within the industry sector. Enterprises plan for a reduction in energy consumption through their 5-year programmes, and are financially rewarded/penalised for final outcomes. The 5-year energy consumption reduction plans are based on compulsory energy audits and calculations that take into account the previous five years consumption patterns and future output and economic activity.

Energy efficiency in the industry sector will be achieved primarily through the introduction of modern energy-efficient technologies, energy-saving equipment and materials in all sectors of the economy and individual technological processes, as well as through economic restructuring aimed at the development of less energy-intensive industries, promotion of energy saving activities and rational use of fuel and energy resources.

Supply Side Measures:

- Increasing the energy efficiency of existing energy sources of the Belarusian energy system and decommissioning of inefficient energy sources;
- Reduction of energy consumption for the production and transmission of electric and thermal energy in the Belarusian energy system;
- Introduction of organizational and technical energy saving measures for the integration of the Belarusian nuclear power plant into the Belarusian energy system;
- Creation of automated control systems for heat supply and heat consuming complexes, including the “sources - heat networks - consumers” complexes, with control of heat and hydraulic regimes in cities with a population of at least 100,000 population;
- Introduction of heat recovery systems for exhaust flue gases at energy sources with an installed heat capacity of 100 Gcal / h and above. This requirement also applies to other sectors outside of energy supply (e.g. industry, large buildings).

Since 2016, all existing natural gas-fired boilers must meet specific consumption of not more than 155 kg U / Gcal (1.085 MJ/MJ). This means that the energy efficiency of all newly installed boilers must be at least 92 %.

In industry, by 2020, the specific consumption of fuel and energy will be reduced by at least 2 % compared with the 2015 level by the following demand side measures supported in the State Programme on Energy Savings:

General Measures:

- Transformation of enterprises, aimed at the creation of less energy-intensive, competitive, export-oriented products;
- Improving the structure of production due to the specialisation and concentration of individual energy-intensive industries (foundry, thermal, electroplating and others) by region in order to decommission low-loaded and inefficient equipment;
- Modernisation of production equipment based on modern energy-saving technologies;
- Use of electric infrared emitters for heating industrial premises and technological needs.

Construction Sector:

- Production of building materials using the latest energy-saving technologies;
- Design and construction of energy efficient buildings, including the use of innovative technologies for the use of renewable energy sources;
- The use of petroleum coke and peat briquettes (local sources) to replace gas in cement production plants.

Agriculture Sector:

- Installation new energy-saving technologies in livestock and poultry complexes;
- Installation of energy-efficient grain drying installations, including local fuel and energy resources;
- Modernisation of heating systems (boiler replacement, reduction of heat losses).

Petrochemical Sector:

- Optimisation of a coking unit at the joint-stock company "Naftan" using petroleum coke;
- Optimisation of electrical energy consumption in the transport of oil and petroleum products by installation of more efficient pumps.

Potential new energy efficiency measures:

Energy Management Systems (EnMS)

An energy management system is a system that includes a number of processes for the optimisation of the operation of energy use. These processes include the best operating practices, applying continuous improvement procedures, integrating energy management elements into the investment decision process, monitoring, analysing and reporting energy efficiency results, and checking the functionality and setting of measurement and control systems. An EnMS involves installing sub-metering to segment the energy usage into the main measurable areas or processes, and a software tool to monitor and analyse the results. It is most effective in larger industrial complexes or organisations with multiple buildings.

Defining the benefits of energy management is more complicated than of conventional energy saving projects. In particular, there is a need to distinguish between the benefits achieved as a direct result of the energy management system operation and those achieved through sequential projects (technical saving measures). The first group includes cost-free or low-cost measures that are identified during the analysis of how energy facilities operate, energy flows, workflows, etc. Usually, these measures reduce the waste of energy and increase the control of energy use. Often, this group of benefits also includes early identification fault conditions, prevention of emergency conditions, etc.

The cost of an energy management system implementation depends on a number of factors. The most important factor is the size and segmentation of the energy use, and the demands on secondary metering, data collection and processing. Excluding very small and extremely large systems of energy usage, the cost of implementing an energy management system could typically be between 10,000 and 1,000,000 BYN.

Calculation methodology: The implementation of an energy management system resulted in a reduction of 1.0% of the final energy consumption in the industry sector in the Czech Republic. With the introduction of this measure in Belarus, it is estimated that approximately 8.4 kt c.e. of annual energy savings can be made during the period 2022-2030. The calculation methodology is based on the final energy consumption in industry in 2017.

Final energy consumption in industry sector: 8,425 kt c.e.

1% of final energy savings: 8,425 x 0.01 = 8.4 kt c.e.

Cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0	8.4	16.9	25.3	33.7	42.1	50.6	59.0	67.4	75.8	**379**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-26 Energy Management Systems (EnMS) – energy savings, CO_2 savings and costs

Period of implementation	2022-2030
Cumulative energy savings	379 kt c.e.
Cumulative CO_2 savings	656 kt
Investment costs	819 mln. BYN

White Certificates Trades

This measure aims to establish a financial mechanism known as “White Certificates Trades”. Holders of certificates will have achieved energy savings through energy efficiency improvement measures and can sell these certificates on the White Certificate market. Each certificate needs to be issued before being traded.

This mechanism will encourage additional investment in the implementation of energy efficiency measures in final consumption as well as in the production, transmission and distribution of energy. The establishment of Energy Service Companies which implement energy efficiency measures will be stimulated. Energy audit markets will see a growth in business as the trading system will need certificates of achieved energy saving measures. Apart from stimulating the energy efficiency market, the measure will also include a legal framework and scheme evaluation to support the financial mechanism.

A White Certificate system usually operates in three areas:

- Increasing energy savings by end-users;
- Increase energy savings by energy producers from technologies used in their energy production processes;
- Reducing the losses of electricity, heat or natural gas in the transmission and distribution systems.

In several EU countries, the major energy suppliers are required to achieve yearly quantitative primary energy savings. The implementation of “obligated parties” to fulfil the national annual increase in energy efficiency would help to stimulate the financial mechanism.

The obligated parties may satisfy the requirements of the scheme either by producing White Certificates awarded for energy efficiency projects, or by purchasing White Certificates from other parties. Otherwise financial penalties are applied

The following "voluntary subjects" can access the white certificates mechanism and present energy efficiency projects:

- An Energy Service Company (ESCO);
- Company which has fulfilled the obligation to appoint an energy manager;
- Distributors of electricity or gas;
- Companies operating in the industrial, residential, commercial, agricultural, transport and public services, including public bodies.

Each award or purchase of White Certificates must lead to exemption of tax charges, in proportion to the energy savings made.

Calculation methodology: The Italian White Certificate system was used as a role model for the calculation methodology. The Italian White Certificates have been implemented since 2005 and have been subsequently supplemented and modified in order to confirm the achievements of energy savings by improving energy efficiency in all sectors, except for transport. However, 80 % of the White Certificates come from the industrial sector. The Italian White Certificates contributed to an annual final energy savings of 0.15 % during 2005-2012.

A lower percentage (0.015%) was used for the calculation of the annual energy savings introducing White Certificates in Belarus, because similar measures are introduced in the State Energy Saving Programme. Following the Italian scheme, the annual energy saving is calculated based on the final energy consumption in 2017 in industry, agriculture, forestry and fishing, construction and services.

The investment costs will be similar to the State Energy Savings Programme because similar technical measures will be implemented.

Final energy consumption in industry, construction, agriculture, services and residential: 20,223 kt c.e.

0.015% of final energy savings: 20,223 x 0.015% = 3.03 kt c.e.

Cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0	0	0	0	0	3.0	6.1	9.1	12.1	15.2	**46**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-27 White Certificates Trades – energy savings, CO_2 savings and costs

Period of implementation	2026-2030
Cumulative energy savings	46 kt c.e.
Cumulative CO_2 savings	76 kt
Investment costs	110 mln. BYN

Technology and Green Procurement

Technology and green procurement is a method to trigger producers to develop more energy efficient products and systems. A procurement competition for new technology brings the most influential customers together in a single group of potential buyers. This could be an effective measure in Belarus because many industrial enterprises are state owned so it should be relatively easy for them to form procurement consortia.

The procurement consortium prepares an enquiry specification and negotiates with manufacturers, resulting in more consistent demand for products. The procurement competition proceeds according to the following steps:

1. The Consortium is formed.

2. Each purchaser pledges to buy a specific amount of the winning product.

3. The Consortium identifies its needs and expresses its requirements in a detailed list (the enquiry specification).

4. The manufacturers issue a detailed technical description of their proposed or actual product.

5. Prototypes of the products which comply with the specification are ordered and tested.

6. Limited numbers of the best product or products are ordered and tested.

7. One or more winners are selected. Winners are rewarded by the sales generated by the consortium.

The whole procedure could be financially assisted through future State Energy Savings Programmes.

Calculation methodology:

In Sweden, after implementation of technology procurement in the industry sector in the period from 2010 – 2016 savings of 0.054 % of final energy consumption were achieved. With the introduction of this measure in Belarus, it is estimated that approximately 4.6 kt. c.e. of annual energy saving could be achieved once the scheme is fully established. The result for Belarus was calculated from the data on final energy consumption for 2017 from BelStat and the percentage savings achieved in Sweden.

The investment costs will be similar to the State Energy Savings Programme because similar technical measure will be implemented.

Final energy consumption in industry: 8,425 kt c.e.

0.0544 % of final energy savings: 8,425 x 0.0544% = 4.6 kt c.e. Cumulative energy savings are as illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0	0	4.6	9.2	13.8	18.3	22.9	27.5	32.1	36.7	**165**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-28 Technology and Green Procurement – energy savings, CO_2 savings and costs

Period of implementation	2023-2030
Cumulative energy savings	165 kt c.e.
Cumulative CO_2 savings	285 kt
Investment costs	97 mln. BYN

3.4.2 Savings arising from industry measures

The savings and investment costs for the two years 2016 and 2017 from individual measures in the industry sector under the State Programme for Energy Savings are shown in the following table.

Table 3-29 Measures implemented in the Industry Sector under the State Programme on Energy Savings 2016-2017

Measure	Energy savings [t c.e.]	Energy savings [TJ]	Investment costs [th. BYN]
Replacing inefficient electric boiler rooms and electric water heaters with heat sources operating on local fuel and energy resources and highly efficient electric heaters	12,933	379	6,378
Decentralization of air supply with the installation of local compressors	4,238	124	2,222
Decentralization of exhaust air removal systems with the installation of local suction	295	9	58
Decentralization of heating	119	3	90
Decentralization of refrigeration with the installation of local refrigeration	581	17	396
Decrease heat losses	24,042	705	76,136
Energy management system	10,456	306	15,226
Fuel switch (from electricity to local source)	20	1	1
Elimination of inefficient electric heating with the transfer of technological equipment to modern highly economical energy sources (natural gas, high-temperature liquids, etc.)	138	4	69
Fuel switch (from liquid fuels to gas)	11	0	48
Fuel switch (local source utilization)	447	13	1
Heat supply optimization	161,099	4,721	62,829
Implementation of IT technologies	59	2	166
Increase energy efficiency in gas burning devices	6,013	176	5,521
Increase use of renewables for electricity	2	0	1
Increase use of renewables for heat production	165	5	4,166
Installation of a new power plant (steam, gas, CHP)	49,806	1,460	22,697
Installation of automation of fuel combustion	1,219	36	1,093
Installation of cogeneration	10,828	317	7,050
Installation of frequency converters	14,862	436	10,746
Installation of new boilers using local fuel (biomass, peat)	2,717	80	2,496
Installation of new energy-efficient technologies	450,760	13,211	502,288
Insulation of buildings	14,013	411	16,781
Lighting	21,854	640	13,185
Metering	5,734	168	2,452
Other measures	262,783	7,702	93,982
Other measures in boilers	12,979	380	6,673
Other renewables	17,733	520	24,968
Pump replacement	8,900	261	4,514
Total	**1,094,803**	**32,086**	**882,233**

Source: Evaluation of the State Programme on Energy Savings

It is evident that the largest savings from a single category are in the installation of new energy efficient production technologies (Other Measures includes around 30 different smaller measures). Significant savings have also been made on the supply side through boiler replacements, reduction of losses on the heat supply network and heat supply optimisation.

The savings arising from new potential measures in industry are summarised in the following table.

Table 3-30 Savings arising from measures in industry

	Cumulative primary energy savings 2021-2030 [kt c.e.]	Cumulative final energy savings 2021-2030 [kt c.e.]	Renewables 2021-2030 [kt c.e.]	CO_2 reduction [kt]
Energy Management Systems (EnMS)	0	379	0	656
White Certificates trades	0	46	0	76
Technology and Green Procurement	0	165	0	285
Total	**0**	**590**	**0**	**1,017**

3.4.3 Timing of measures in industry

Figure 3-7 Timeframe of measures in industry

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Potential measures											
Energy Management Systems (EnMS)	2022		●								►
White Certificates trades	2026						●				►
Technology and Green Procurement	2023			●							►

3.4.4 Financing of energy efficiency measures in industry

Financing of energy efficiency improvements in industry has mainly been from own funds and bank loans, in some cases supplemented by local funds and grants. However, EBRD has financed several industry sector projects in the last two years including:

- The Belarus Sustainable Energy Finance Facility (BelSEFF) which part-funded energy efficiency and small-scale renewable energy projects in the sector – EUR 30M;
- A 6.58 MWt combined cooling and heating plant (CCHP) and new warehouse for meat processing at the Servolux meat plant – EUR 10M;
- Installation of a 2.4 MWe combined cooling, heat and power plant (CCHP) in the toy manufacturing company PP Polesie JLLC. The implementation of the project is expected to result in electricity savings of around 3,000 MWh per year, gas savings of 24,100 MWh per year and CO_2 savings of 7,500 tonnes per year – EUR 10M.

It is anticipated that most of the financing for energy efficiency measures in industry will continue to come via the State Energy Savings Programmes, though the use of the EPC/ESCO model could also play a role in this sector. The IFIs are also showing increased interest in financing projects in the industry sector.

3.4.5 Recommended actions for measures in industry

- Improve existing monitoring of energy savings and find new energy savings measures in enterprises within their 5-year programmes by implementation of EnMS.
- Establish the preparatory phase for the White Certificates complementary to the State Energy Savings Programme.
- Integrate Technology and Green Procurement in the State Energy Savings Programme.

3.5 Energy efficiency measures in transport

3.5.1 Main policy measures addressing energy efficiency in transport

Transport Buildings

The Ministry of Transport operates a large number of buildings in its own estate. The savings made to date from different measures are shown in the following table.

Table 3-31 Energy efficiency measures implemented in the State programme on energy savings 2016-2017 by Ministry of Transport (Buildings only)

Measure	Energy savings [t c.e.]	Energy savings [TJ]	Investment costs [th. BYN]
Boiler replacement	236	6,9	365
Decentralization of air supply with the installation of local compressors	72	2,1	15
Decentralization of exhaust air removal systems with the installation of local suction	3	0,1	4
Decrease heat losses	1,359	39,8	2,275
Energy management system	86	2,5	34
Fuel switch (from electricity to local source)	3	0,1	0
Fuel switch (from electricity to natural gas)	17	0,5	0
Heat supply optimization	3,266	95,7	1,314
Implementation of IT technologies	42	1,2	11
Increase energy efficiency in gas burning devices	76	2,2	15
Increase use of renewables for electricity	3	0,1	0
Installation of a new power plant (steam, gas, CHP)	967	28,3	10,938
Installation of automation of fuel combustion	10	0,3	35
Installation of cogeneration	493	14,4	83
Installation of frequency converters	161	4,7	133
Installation of new energy-efficient technologies	4,804	140,8	4,188
Insulation of buildings	2,463	72,2	6,343
Lighting	4,213	123,5	3,949
Metering	573	16,8	130
Other measures	14,704	430,9	1,213
Other measures in boilers	660	19,3	1,759
Other renewables	161	4,7	32
Pump replacement	342	10,0	204
Total	**34,712**	**1,017,3**	**33,041**

The largest savings have been achieved through lighting improvements, decreasing heat losses, heat supply optimisation and installation of new energy efficient technologies. Other measures includes a range of around 30 smaller individual improvements.

Transport Vehicle Mix

The following table shows the numbers of different categories of vehicles and the percentage change from 2011 to 2017.

Table 3-32 Number of vehicles

	2011	2012	2013	2014	2015	2016	2017	Percent change 2011-2017
Government transport vehicles of which:	415,298	424,051	428,950	438,982	436,812	427,015	425,495	2.5%
Trolleybuses	*1,775*	*1,741*	*1,752*	*1,749*	*1,699*	*1,610*	*1,536*	*-13.5%*
Tramway cars	*276*	*273*	*283*	*284*	*322*	*313*	*306*	*10.9%*
Metro cars	*302*	*337*	*336*	*361*	*361*	*361*	*361*	*19.5%*
Motor road transport vehicles of which:	*412,945*	*421,700*	*426,579*	*436,588*	*434,430*	*424,731*	*423,292*	*2.5%*
Freight	*275,328*	*279,841*	*285,388*	*285,556*	*282,437*	*275,976*	*268,905*	*-2.3%*
Passenger cars	*104,048*	*107,775*	*107,318*	*115,403*	*117,013*	*116,100*	*122,054*	*17.3%*
Buses	*33,569*	*34,084*	*33,873*	*35,629*	*34,980*	*32,655*	*32,333*	*-3.7%*
Private transport vehicles of which:	2,777,149	2,774,832	2,810,281	2,974,232	3,067,551	3,100,735	3,121,093	12.4%
Freight transport vehicles	*121,133*	*123,274*	*128,805*	*135,632*	*135,569*	*138,388*	*137,291*	*13.3%*
Passenger cars	*2,646,507*	*2,640,759*	*2,670,600*	*2,827,200*	*2,920,200*	*2,951,400*	*2,972,700*	*12.3%*
Buses	*9,509*	*10,799*	*10,876*	*11,400*	*11,782*	*10,947*	*11,102*	*16.8%*

Source: Belstat

Although there has been an increase in the number of trams and Metro vehicles, it is clear that the largest increase in vehicles is in passenger cars. This leads to the conclusion that measures need to be aimed at encouraging the use of public transport and increasing the efficiency of private cars.

Planned Measures

The following measures are planned to improve overall energy efficiency of the transport fleet and to reduce the use of liquid fuels.

Construction of an electric charging infrastructure

One of the main planned measures to improve overall energy efficiency in transport is the construction of an electric charging infrastructure for electric vehicles. The European Union has indicated that electric vehicles and charging infrastructure are a major transportation priority, and is considering extending its vehicle CO_2 regulations to 2025 or 2030 to promote electric vehicles, among other policy approaches. The EU has also directed all Member States to ensure that recharging points accessible to the public are built up with adequate coverage, in order to enable electric vehicles to circulate at least in urban/suburban agglomerations and other densely populated areas.

In accordance with the Resolution of the Council of Ministers of the Republic of Belarus No. 731 *"On Approval of Programs for Creating a State Charging Network for Electric Car Charging"* of October 2018, the construction of 431 electric car charging stations is planned (with a charging time of 4-8 hours).

In 2018, within this program, 65 electric car charging stations were built, bringing the total number of electric car charging stations to 80 units. Minsk has the highest concentration of charging stations (36 electric car charging stations), located at the parking lots of business centres, office buildings, residential areas, and close to historical, cultural and sports facilities.

40 electric car charging stations have been built at the filling stations of the State Production Association Belorusneft, which are located on the main roads of the Republic, in regional cities and regional centres. These aim to provide electric vehicles with an average of 150 km between charging stations throughout the country.

At the same time, a low rate of increase of the electric vehicle fleet in the Republic has been seen. This is due to the absence in the country of such benefits as preferential loans to individuals and legal entities when buying electric cars as a cost incentive to purchase domestic electric transport, and the establishment of zero rates of import customs duties and VAT for individuals and legal entities when importing electric vehicles.

In addition it is necessary to develop and approve a set of measures for supporting the change from internal combustion engines to electric vehicles.

The first stage (up to 2021 inclusive) includes the construction of 431 electric car charging stations in Minsk. This will allow for charging of around 6000 electric vehicles.

The second stage is planned to be implemented in 2022-2025, subject to an increase in the number of electric vehicles in Belarus over 10 thousand units.

The third stage is planned to be implemented in 2026-2030, subject to an increase in the number of electric vehicles to over 25 thousand units.

It may also be necessary to introduce financial incentives such as a partial grant or low cost loans to encourage the uptake of electric vehicles amongst the general population.

Other Measures

Other planned measures addressing energy efficiency in transport include:

- Updating the fleet of motor vehicles, as well as machinery and equipment to decommission worn-out vehicles;
- Installation of equipment for monitoring fuel consumption, development of norms of fuel consumption for different routes;
- Introduction of modern equipment for the diagnosis, maintenance and repair of vehicles, machines and mechanisms
- Introduction of automated traffic management systems and for the carriage of goods and passengers;
- Increasing the efficiency of public vehicles usage, and optimisation of the vehicle fleet structure;
- Increasing the use of biodiesel;
- Electrification of some railway sections ;
- Increasing staff training and qualifications.

Potential New Energy Efficiency Measures in Transport

Sustainable Urban Mobility Plans (SUMP)

The aim of the measure is to motivate large municipalities to draw up Sustainable Urban Mobility Plans whose objective is to promote more sustainable means of transport. The SUMP, coordinated with the Urban Traffic Plans, considers the whole structure of transport within the urban areas including:

- Infrastructure
- Parking areas
- Technologies
- Public fleets
- Demand control systems
- Logistics
- Freight infrastructure

A SUMP usually includes initiatives such as:

- Car-sharing and car-pooling
- Cycling and pedestrian paths

- Modal interchange stations
- Restricted traffic areas
- Improved quality of public transport
- Flexible transport services, adapted to demand
- Teleworking
- Logistic centres to regulate loading and unloading.

These actions include various elements in the whole structure of transport that lead to efficient mobility in cities with a population over 50,000. Promoting actions to reduce energy consumption in transport improves the living standards of citizens. Implementation of such activities makes important changes in urban areas towards emission reduction, energy saving and reduction of fossil fuel consumption.

The Ministry of Transport (MoT) will need to draft the basic legislation on mobility and will establish a technical and economic support system to introduce SUMPs by agreeing with individual cities the investment required. In parallel, the Ministry should develop publicity campaigns for a new type of urban mobility.

Development of a SUMP will be reviewed and appropriate measures described as part of the current EBRD project "Green City Action Plan for Minsk" and in some cities under their Covenant of Mayors programmes. Some SUMPs have also been developed under the UNDP GEF "Green Urban" Programme.

Calculation methodology: The EU Commission has estimated that the implementation of the comprehensive set of recommendations from the SUMP process in a given city can lead to a CO_2 emission reduction of between 35% and 70% by 2040.

The implementation of this measure depends on a reduction in the use of individual cars and the combination of actions for more efficient use of transportation. Therefore, the SUMP strategy includes a 20% modal switch of passenger-kilometres from individual car transportation to public transport in urban areas.

Calculation of energy savings is based on the final energy consumption of individual cars in urban areas (40 % of total transport consumption) and the specific consumption of cars (1.6 MJ/pkm[43]) and buses (0.63 MJ/pkm[44])

Final energy consumption in transport sector:

- Motor gasoline 1,709 kt c.e.
- Diesel oil 2,675 kt c.e

Energy consumption of individual cars in urban areas:

- Motor gasoline 0.4 x 1,709 = 684 kt c.e.
- Diesel oil 0.4 x 2,675 = 1,070 kt c.e

Modal switch of 20% gives 0.2 x 0.63/1.6 x 684 + 0.2 x 0.63/1.6 x 1,070 = 139 kt c.e

139 kt c.e. of energy savings will be achieved in 2030.

Cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total [kt c.e.]
14	28	42	56	70	84	97	111	125	139	766

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

[43] Source: https://odyssee.enerdata.net/database/, average specific consumption of all EU states, specific consumption for Belarus is not available
[44] Source: Belstat: Energy intensity of transport

Table 3-33 Sustainable Urban Mobility Plans (SUMP) – energy savings, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative energy savings	766 kt c.e.
Cumulative CO_2 savings	1,321 kt
Investment costs	10,000 mln. BYN

Investment costs also include also investment in infrastructure, which does not lead directly to energy savings.

Eco-driving for Professional Drivers

The efficient driving of lorries and buses is improved by the establishment of efficient driving techniques for both new and experienced heavy duty vehicle drivers.

The mechanisms considered within this measure are as follows:

- Legislative: Formal introduction of standards for efficient driving techniques in the training and assessment system to obtain a driving license for trucks and buses. The training can be obligatory or voluntary.
- Economic incentives: ranging between 50% and 100% of the training costs
- Information: drafting of both publications and dissemination material on the efficient driving of trucks and buses.

The Ministry of Transport should be responsible for the implementation of these actions.

The training consists of theoretical and practical parts, where the spontaneous and individual driving performance of the participants is compared with the results of new driving techniques developed on the basis of information obtained and instructions given during the training. The training vehicles can be equipped with appropriate software able to record and then analyse the vehicle driving technique and define the safest and most economical method of vehicle use.

Calculation methodology:

Based on the statistical data of the Ministry of Transport in Finland, the implementation of a measure to include eco-driving elements into driver educational courses resulted in a reduction of fuel consumption in public transport and freight vehicles of 4 to 8%.

The calculation methodology is based on the total fossil fuel consumption in public transport and freight transport in Belarus in 2017, a 4% reduction in the fossil fuel consumption (taken from the Finnish statistics) and that 10% of drivers receive training by 2030.

Final energy consumption of gasoline, diesel and LPG in public and freight transport: 4,519 kt c.e.

4 % of final energy savings: 4,519 x 0.04 = 181 kt c.e.

10 % of drivers will receive the training in the period 2026 - 2030: 181 x 0.1 = 18.1 kt c.e.

Cumulative energy savings are illustrated below:

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	**Total [kt c.e.]**
0	0	0	0	0	3.6	7.2	10.8	14.5	18.1	**54**

CO_2 savings were calculated using emission factors in the LEAP model (see Annex F).

Table 3-34 Eco-driving for Professional Drivers – energy savings, CO_2 savings and costs

Period of implementation	2026-2030
Cumulative energy savings	54 kt c.e.
Cumulative CO_2 savings	93 kt
Investment costs	14 mln. BYN

3.5.2 Savings arising from transport measures

Savings arising from new transport measures are summarised in the following table.

Table 3-35 Savings arising from transport measures

	Cumulative primary energy savings 2021-2030 [kt c.e.]	Cumulative final energy savings 2021-2030 [kt c.e.]	Renewables 2021-2030 [kt c.e.]	CO_2 reduction [kt]
Sustainable Urban Mobility Plans	0	766	0	1,321
Eco-driving for Professional Drivers	0	54	0	93
Total	**0**	**820**	**0**	**1,414**

3.5.3 Timing of measures in transport

Two cities (Polotsk and Novopolotsk) have already developed their Sustainable Urban Mobility Plans. More cities will follow in the next few years. The first benefits of Eco-driving for Professional Drivers are expected in 2026 due to legislative procedural work that has to precede the implementation.

Figure 3-8 Timeframe of measures in transport

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Potential measures											
Sustainable Urban Mobility Plans (SUMP)	2021										
Eco-driving for Professional Drivers	2026										

3.5.4 Financing of energy efficiency measures in transport

So far there has been little IFI activity in the transport sector in Belarus, though the Covenant of Mayors programme includes transport and so will lead to some projects in the sector. A UNDP/GEF project - Supporting Green Urban Development in Small and Medium-Sized Cities in Belarus (2016-2021) is under implementation in partnership with the MinNREP. This project includes pilot initiatives on sustainable urban transport in Polotsk and Novopolotsk as well as energy efficiency improvements in Novogrudok (replacement of street lighting with LED, the installation of a smart metering system for energy resources at residential facilities) –*EUR 3M.*

Both the World Bank and EBRD are actively financing improvements in the transport system in other countries in the region. For example, EBRD is funding the purchase of CNG and electric buses in Tbilisi and Batumi (Georgia) and new trolley buses and trams in Lviv (Ukraine). Discussions with the IFIs should take place to determine what similar projects could be financed in Belarus, for example as part of the Green City Action Plan for Minsk.

3.5.5 Recommended actions for measures in transport

- Cooperate with city representatives of Polotsk and Novopolotsk and subsequent cities in implementation of SUMPs.
- Decide whether training in Eco-driving for Professional Drivers will be obligatory and defined by legislation or the training will be on voluntary basis. Consider economic incentives for training courses.

3.6 Promotion of efficient district heating

A comprehensive assessment of district heating systems was undertaken as part of the State Energy Saving Programme 2010 – 2015[45]. It concluded that the biggest potential for high-efficiency cogeneration and efficient district heating (DH) is in big CHP power plants, because many of them are beyond the technical lifetime and are less efficient than the modern CHPs.

By 2020, a significant number of the DH generating sources will come to the end of their planned working life, thus requiring their replacement, modernisation, or a reasonable period of extension of operation. The total capacity of such equipment is 4,745 MWt, including 143 MWt at small thermal power plants (TPPs).

Of the total capacity it is planned that 1,030 MWt will be decommissioned, 1,900 MWt will be put into cold reserve, 500 MWt will be replaced and 1,315 MWt will be modernised.

In the State Energy Savings Programme for 2016-2020 the following measures are planned:

- Development of a regulatory legal framework to ensure effective interaction of heat energy producers, organisations involved in its transportation and distribution, and consumers;
- Installation of heat pumps using low-grade heat from DH systems and power plants;
- Using biomass in heat supply system boilers;
- Development of automatic and automated control systems for heat supply (sources, heating networks, consumers);
- Reduction of heat losses by reconstruction of heating networks using new high-performance thermal insulation materials;
- Replacing 80–100 km of DH distribution pipelines annually, provided that financing sources are made available.

Energy savings arising from the above measures are already accounted for in the State Energy Saving Programmes discussion in Section 3.1.2. Further cost benefit analyses of cogeneration will be undertaken in future years.

There is also a recognised need to develop and implement a coordinated policy in the field of balance of the heating networks and boilers between the Ministry of Energy, the Ministry of Housing and Communal Services, Regional Executive Committees and the Minsk City Executive Committee for replacing outdated heating networks, connecting new consumers, accepting additional heat loads from housing, utility organisations and industrial consumers.

3.7 Energy transformation, transmission, distribution, and demand response

3.7.1 Energy efficiency criteria in network tariffs and regulations

Tariffs

Belarus has developed a complex system of subsidisation and cross-subsidisation of energy tariffs. There is currently a cross-subsidisation of heat tariffs by electricity consumers, and a cross-subsidisation of households by industrial consumers. Finally, this does not preclude the direct subsidy of energy tariffs by local and national budgets. The legal basis of state pricing policy in the Republic of Belarus was established by the Law of the Republic of Belarus of 10 May 1999 No. 255-3“ On Pricing ”. Price (tariff) regulation is based on the Decree of the President of the Republic of Belarus of February 25, 2011 No. 72 “On some issues of price (tariff) regulation in the Republic of Belarus”.

Ending (cross-)subsidisation is regularly indicated as a major structural issue in the Belarusian energy sector and is thus correspondingly a priority of the government. The phase-out of (cross-)subsidisation will be carried by the progressive termination of preferential energy tariffs for certain legal entities and small businesses, and also by ensuring the growth of real incomes of the population and the development of a system of targeted subsidies to certain categories of citizens.

[45] http://minenergo.gov.by/dfiles/000490_631233__1076.doc?csspreview=true

Preferential tariffs for industrial customers were already eliminated in 2012, while household VAT exemption for utilities was phased out in 2016. In order to further reduce cross-subsidisation and ensure the balance of interests of consumers and energy supplying organisations, the Council of Ministers of the Republic of Belarus adopted a decree dated March 17, 2014 No. 222 “On approval of the Regulation on the procedure for setting prices (tariffs) for natural and liquefied gas, electric and thermal energy ". This decree determines the pricing of natural gas, liquefied gas, tariffs for heat and electricity. Formulation of electricity tariffs is carried out on the basis of the costs associated with the production, transmission, distribution and sale of a unit of electrical energy, tax and non-tax payments, as well as the funds required for the expanded production of energy supplying organisations for this type of activity.

However, governmental (extra-)budgetary contributions are still allowed by the Decree 222. The elimination of (cross-)subsidies is complicated by circumstances such as the consideration of the social impact, past economic crises, the price increases for fossil fuel imports and the Belarusian currency depreciation. Moreover, while the phase out of subsidies in the gas and electricity sector is easier, this is more difficult in the heat sector, given the importance of the heating cost to total energy expenditures.

Hence the current policy on tariffs includes:

- A reduction of cross-subsidies in tariffs, taking into account the planned growth of real incomes of the population and the system of targeted subsidies to certain categories of citizens;
- Development of a system of regulatory legal acts on the formation of electricity tariffs by type of activity (production, transmission, distribution and sale) on the basis of separate accounting and in accordance with the stages of reforming the energy system;
- Expansion of methods and methods of tariff regulation applied in the context of the types of activities: production, transmission, distribution and sale;
- Differentiated tariffs for thermal energy in terms of heat carrier;
- Optimisation of tariff levels for electricity used for heating and hot water supply;
- Optimisation of the levels of electricity tariffs for consumers making payments for electricity at different time periods;
- Expansion of the list of categories of consumers, and implementing appropriate tariffs differentiated by time periods.

Transformation of the Electricity Supply Sector

The main event in the development of electricity generating sources in the period under review is the commissioning of the first unit of the nuclear power plant (NPP) in mid-2020 and the second in late 2021 giving a total new capacity of 2,400 MW. This will require effective integration into the balance and mode of operation of the power system.

In case of emergency shutdown of a power unit at the nuclear power plant, it is vital to restore the planned capacity of the power system in a short time. Hence it is necessary to hold at least 1,200 MW of hot and cold reserve on standby. This amount of reserve for emergency shutdowns and for power reduction due to repairs are planned to be covered by maintaining the operational status of individual units at the Lukoml State District Power Plant and, partly, by other operating TPPs.

To regulate the minimum loads of the power system after commissioning the full capacity of the NPP without implementing special measures, it would be necessary to shut down all condensing units and heating power plants at TPPs at night, which is unacceptable to maintain the reliability and safety of the smaller power plants. For this reason, it is envisaged to implement a number of special measures in the form of installation of electric boilers at the facilities of the Belenergo State Production Association, as well as to increase the use of electricity for heating and hot water from other consumers, including heating of newly constructed residential areas and individual development. This will include a flexible tariff policy that stimulates the use of electricity in the period of minimum loads of the power system and dis-incentivises usage during the periods of peak demand. Regulation of peak loads will also be achieved through the use of gas turbines and gas engines.

The LEAP model will be used to assess the proposed measures in terms of their impact and cost to determine the optimal mix of measures. Where appropriate alternative measures will be proposed.

According to the latest forecast, the total installed capacity of the power system at the end of 2020 will be about 12,841.9 MW, including:

- the power plants operated by Belenergo including the first unit of the NPP (11,425.4 MW);
- local sources (around 1,416.5 MW, of which 636.3 MW will based on renewable energy sources).

The total capacity of renewable energy sources will be about 5 percent of the total installed capacity of the power system by 2020.

By 2020 it is planned to introduce new capacity (including installation of new plant and replacement of retiring plant) of 340.3 MW. In the same timescale it is planned that 246 MW of obsolete capacity at certain facilities will be decommissioned meaning that the nett increase in capacity will be 94.3 MW. Possible amounts of further decommissioning of individual units at other TPPs will be determined after the design capacity of the NPP is reached and it is fully integrated into the balance of the power system.

Electricity transmission and distribution system

Many of the power lines and substations in the electricity supply system have been operating for more than 25 years and are reaching the end of their design life. Consequently they are showing various degrees of wear and tear and therefore need replacement or reconstruction. This applies to:

- Between 65 and 80% of main substations;
- 47% of 750 kV transmission lines;
- 70% of 330 kV transmission lines;
- 62% of 110 kV transmission lines;
- 75% of 35 kV transmission lines;
- 62% of 10 kV transmission lines.

The construction of new transmission lines and substations, the reconstruction of existing substations, and a number of other measures are planned for ensuring the delivery of power from the nuclear power plant, improving the reliability of power supply to individual regions and sustaining the operation of the power system under various operating conditions.

A reconstruction and replacement programme undertaken by the State Production Association "Belenergo" from 2016 to 2020 has so far included:

- Construction of new 330kV transmission lines to six substations;
- Construction and reconstruction of 330kV transmission lines to eight existing power plants:
- Construction of one new 330kV substation and the reconstruction of two other 330kV substations.

To further improve the reliability of power supplies to industrial hubs and individual consumers, the following measures are planned:

- Reconstruction of the 750kV "Belorusskaya" substation;
- Construction of one new 330kV substation and the reconstruction of five others:
- Transfer of the 220 kV transmission network to 330kV and 110kV;
- Gradual decommissioning of 35kV transmission lines, transferring to the 110kV or 10kV networks;
- A significant amount of modernisation and technical re-equipment of the 110kV networks and substations with the replacement of equipment that has served its standard operational life;
- Annual construction and reconstruction of around 1,500 km of distribution lines with a voltage of 0.4–10kV (subject to statutory annual update);
- Equipping power lines with emergency control and automatic re-closure systems,
- Integrated systems for power line monitoring and remote microprocessor-based control systems;
- Development and further implementation of "Smart Grids" based on the use of information and communication technologies for collecting information and controlling systems at the stages of production, transmission, distribution and sale of electrical energy.

A further possibility would be for cross-border transmission with Poland via a 400 kV transmission line to transfer up to 500 MW of power. Discussions on this would need to take pace with the Polish electricity authorities. According to "Belenergo" the current (2016-2020) programme should result in savings of fuel and energy of at least 850 thousand tons of coal equivalent.

3.7.2 Facilitate and promote demand response

Apart from the tariff changes and incentives described above, there have been no actions in Belarus to promote demand response amongst final consumers to balance the electricity system. Up to now the system has operated on a traditional “Centralised Thermal Power Station to Transmission System to Distribution System to Consumer” model. However, this will change with the commissioning of the new NPP and the need to increase electricity demand during the night and other low-demand periods. This will be achieved by the construction of electric vehicle charging points and the promotion of electric boilers and other technologies, all backed up by tariff incentives as described earlier.

This topic is the subject of a Presidential Decree which specifies a number of measures including electric boilers for heating and electrification of some industrial processes and railway lines.

The increased use of renewables (particularly local sources) on the electricity system may also lead to a need for demand response measures to be introduced in larger consumers, though at the level of renewables currently envisaged to 2030 (<10%), system balancing should not be a major problem. If the renewables penetration rises towards 8% through new measures proposed in the NEEAP, then demand measures in the form of additional financial incentives may be needed.

Several EU Member States have introduced such incentives including payments for:

- Continuous control of major plant items such as metal melting, frozen food production, cold stores, large buildings (sometimes known as ‘frequency response’);
- Intermittent load shedding as required by the system operator (furnaces, pumps, compressors etc.);
- Starting up standby generators;
- Using battery storage systems.

In some countries (e.g. the UK) payments are made for increasing load in certain periods of high availability of renewables coupled with low demand on the system. Any activities in this area would need to complement the actions already planned to cope with the introduction of the NPP.

3.7.3 Savings arising from all energy supply measures

The measures described above are being implemented mainly for operational and maintenance reasons on the energy supply systems. However some energy savings will be associated with these measures.

3.7.4 Financing of energy supply measures

Financing for energy supply measures comes mainly from the supply organisations themselves except for strategic investments (such as the new nuclear power plant) which are financed from the state budget.

Funding has also been obtained from the IFIs and international organisations, particularly in the area of renewable energy generation. Projects include:

EBRD

- Construction of 2 biogas plants (total 3 MW, 23.6 GWh annually) - Modus Group – *USD 11.3 M.* A second phase of this project for a further three biogas plants with a combined capacity of 5MW was signed in January 2019 – USD 18.4M
- City of Baranovichi – modernisation of wastewater treatment plant + biogas CHP – *EUR 4.3 M.*
- PP Polesie JV - a combined cooling heat and power plant (CCHP plant) – annual electricity 3,000 MWh and gas savings of 24,100 MWh per year.
- Wastewater management systems – Minsk Vodokanal - rehabilitation and optimisation of wastewater treatment plant and the construction of a cost-efficient, modern sludge-management facility. These measures will improve the city’s environment by reducing greenhouse gas emissions by over 130,000 t of CO2 equivalent annually – *EUR 84 M* (together with EIB).

UN ECE - EU4Energy Programme

- Development of wind energy - financial support for the purchase and installation of new wind turbines near the village Grabniki Novogrudok district.

Further financing for this type of project could be anticipated from the IFIs.

3.8 Summary of New Potential Energy Saving Measures

This section summarises the new potential energy saving measures for each sector including their energy and CO_2 reduction. It also describes the effect on achieving the targets.

3.8.1 Measures and Savings

The table below shows the potential new measures for Belarus with their cumulative primary or final energy savings and associated CO_2 reduction.

Table 3-36 New Potential Measures

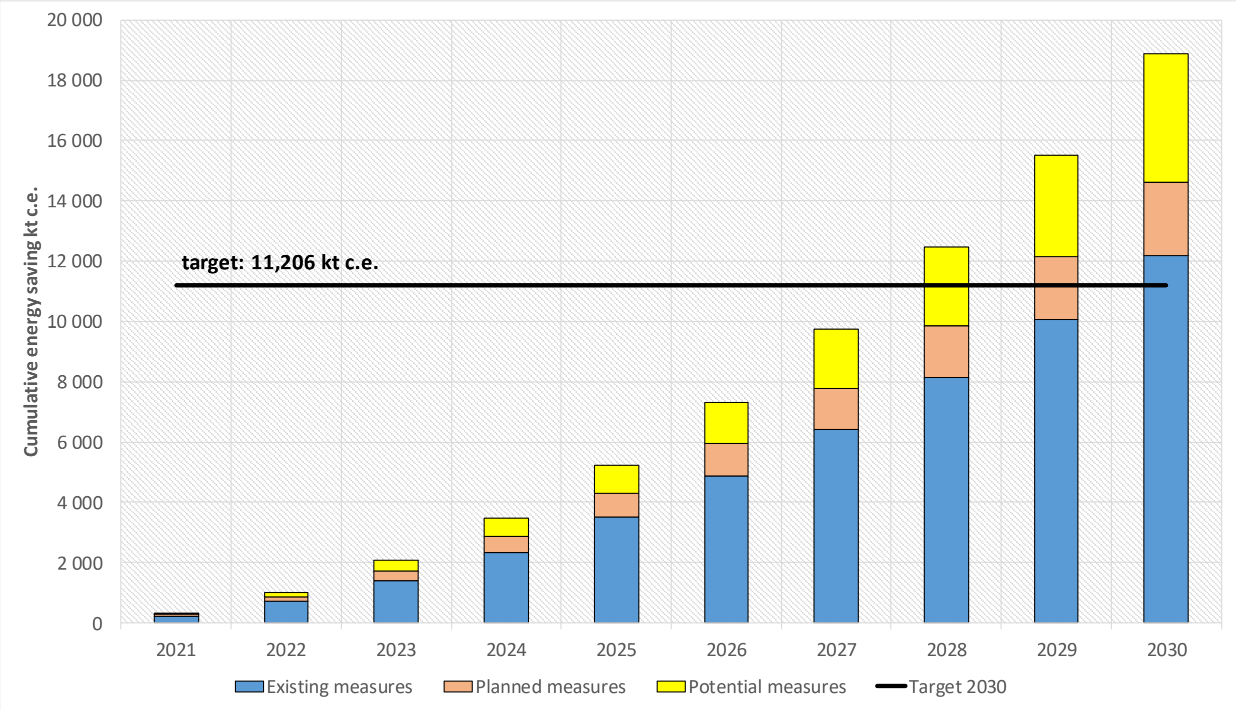
Potential measures	Sector	Cumulative primary energy savings 2021-2030	Cumulative final energy savings 2021-2030	Cumulative renewables 2021-2030	Cumulative CO_2 reduction
		[kt c.e.]	[kt c.e.]	[kt c.e.]	[kt]
Building Renovation Strategy	Buildings	0	1,021	0	860
Sustainable Urban Mobility Plans (SUMP)	Transport	0	766	0	1,321
The “Exemplary State” process	Public	0	66	0	240
Extension of the ESCO Concept	Horizontal	0	448	0	783
Sustainable Energy and Climate Action Plan (SECAP)	Public	43	676	214	1,593
Energy Management Systems (EnMS)	Industry	0	379	0	656
Technology and Green Procurement	Industry	0	165	0	285
Nearly Zero Energy Buildings (nZEB)	Buildings	0	545	185	1,076
White Certificates trades	Industry	0	46	0	76
Eco-driving for Professional Drivers	Transport	0	54	0	93
Totals		**43**	**4,166**	**399**	**6,983**

It is clear that most of the savings from new energy efficiency measures are final energy savings, though some primary energy savings will be obtained through the SECAPs. The biggest savings are expected to arise from wide-ranging initiatives including the Building Renovation Strategy, SECAPs and Sustainable Urban Mobility Plans. These measures are also important for the other benefits they bring to the population such as improved living conditions and reductions in air pollution and traffic congestion. Useful savings contributions also come from the other proposed measures, especially expanding the ESCO concept to the wider public sector and to industry, introducing energy management and monitoring systems in industry together with ‘White Certificate’ trading and adopting the nearly Zero Energy Buildings concept for new construction.

3.8.2 Effect on Targets

The effect on achieving the NEEAP targets from implementing all of the above energy saving measures is shown in the diagram below.

Figure 3-9 Total energy saving in the period 2021-2030 – existing, planned and potential measures



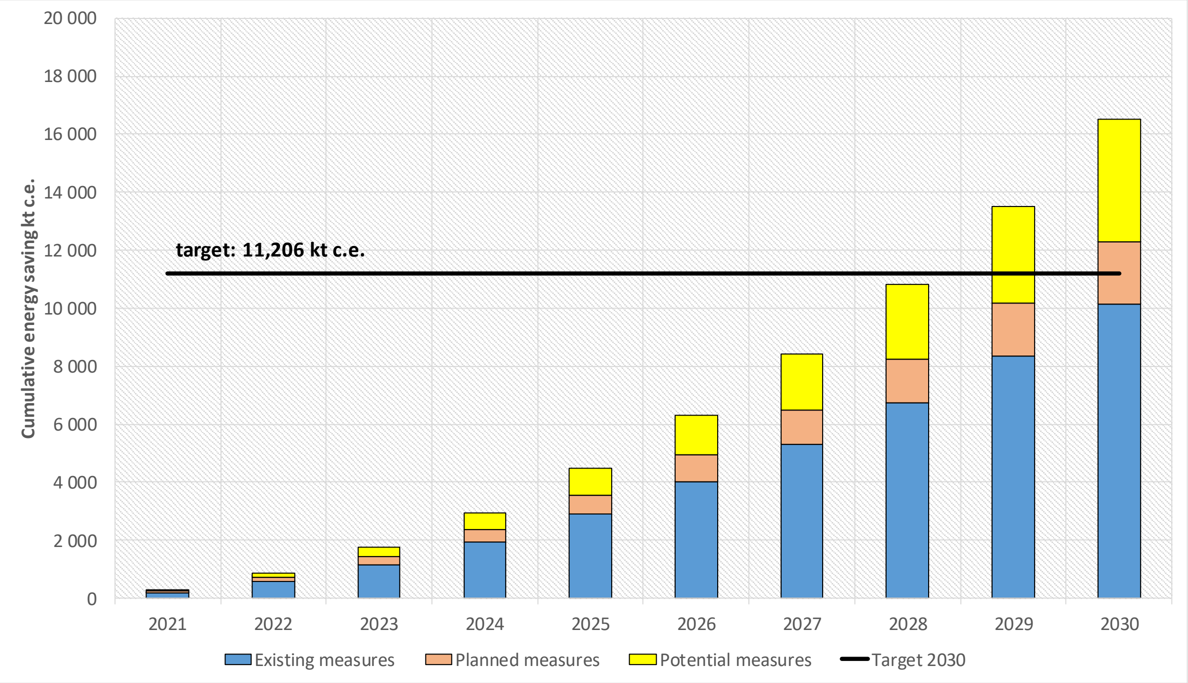
It is evident that the savings from the combined existing, planned and potential measures would take Belarus well beyond the target derived from the EU Energy Efficiency Directive (EED). The main reasons for this are:

- Figure 3-9 includes primary energy savings in addition to final energy savings in line with the usual format in Belarus (e.g. in the State Energy Savings Programme) while the EED target is for final energy savings only. The difference is approximately 2,361 kt c.e. or 12.7% of the total savings.

- Specific energy consumption per unit of GDP is currently significantly higher in Belarus than in the EU so it would be expected that higher savings will be achieved as Belarus implements some of the EU initiatives such as the Building Renovation Strategy and SECAPs.

For comparison Figure 3-10 shows the situation in Belarus if only final (demand side) energy savings are included.

Figure 3-10 Final energy saving in the period 2021-2030 – existing, planned and potential measures



As can be seen the demand side savings are still in well in excess of the NEEAP target.

3.9 Renewables

Renewables are not included in the EU NEEAP targets but are part of the normal monitoring mechanisms in Belarus (e.g. in the State Energy Saving Programme) and so are included in the Belarus NEEAP.

The growth of renewable energy and its increasing contribution to the world's energy mix over the last two decades has been significant. There is scope for increased penetration of all types of renewable energy sources in all sectors but experience in EU countries has shown that financial incentives are necessary to stimulate demand. These incentives are usually based on a price per kWh generated (heat or electricity) and are technology dependent.

In Belarus quotas for renewables are decided for each year and by each type of renewables source (wind, biomass etc.) and are revised annually. These quotas are related to the requirements for energy security and are governed by a 3-stage process:

1. The Ministry of Energy, in cooperation with the State Committee for Standardization and the Ministry of Environment submits calculations of the quotas necessary to ensure the fulfilment of the forecast indicators of energy security (including energy production from RES) to the Republican Interdepartmental Commission for the Establishment and Distribution of Quotas for the Creation of Installations for the Use of Renewable Energy Sources (the 'Commission') for assessment.
2. Quotas for the installation of renewable energy sources are confirmed by the Commission by April 30 of the year preceding the next three-year allocation period and are published on the official website of the Ministry of Energy.
3. The distribution of quotas is carried out on the basis of an evaluation of the proposals of applicants by a Regional Executive Committee taking into account the quantities and types of renewables required to fulfil the quotas.

This system has some similarities with the renewables auction schemes that are now common within the EU. In these schemes organisations can bid for a tranche of renewables capacity for a particular technology at a fixed price per MWh for the subsidy they expect to be paid. The winners in the auction are those organisations that bid the lowest price for each technology.

In Belarus the scope for large-scale renewable electricity is likely to be constrained by the commissioning of the NPP, though reducing peak electricity would still be advantageous by reducing the amount of gas used for electricity generation. Renewable heat production is also desirable, for example from biomass. There is also significant scope for small-scale renewables such as solar PV and heat pumps in the buildings and industry sectors.

Increasing the proportion of renewables in Belarus beyond those required for energy security would reduce the dependence on imported fuels. To achieve the 8% target for 2030 required by the Energy Security Concept it should not be necessary to introduce further financial incentives for bidders into the auction. In addition to the main energy suppliers applicants could include intermediaries such as specialist renewables companies, property developers, industrial complexes, condominium owners, public authorities and ESCOs, all of whom can install renewables technologies at individual premises.

The new renewables could include both electricity (e.g. wind) and heat (e.g. biomass) and would also cover supply side and on-site renewable energy sources such as biomass in small-scale heating plants, solar photovoltaics and solar thermal on building roofs, and electricity generation from landfill gas.

Calculation methodology: Cumulative energy savings in the period of 2021-2030 are calculated based on the assumption, that the share of primary energy production from renewables in primary energy supply will reach 8% by 2030 (the share in 2017 was 6.2%). The 8% figure is lower than for neighbouring countries but recognises the constraints imposed by the NPP. On the other hand Belarus has a significant potential resource base for the development of RES and there is significant potential in wood fuels, wind energy and solar energy. Cumulative primary energy production from additional renewables would be 1,858 kt c.e.in 2030.

Increasing the share of renewables to 8 % would make a significant contribution to the energy balance and to CO_2 reduction in Belarus as discussed below.

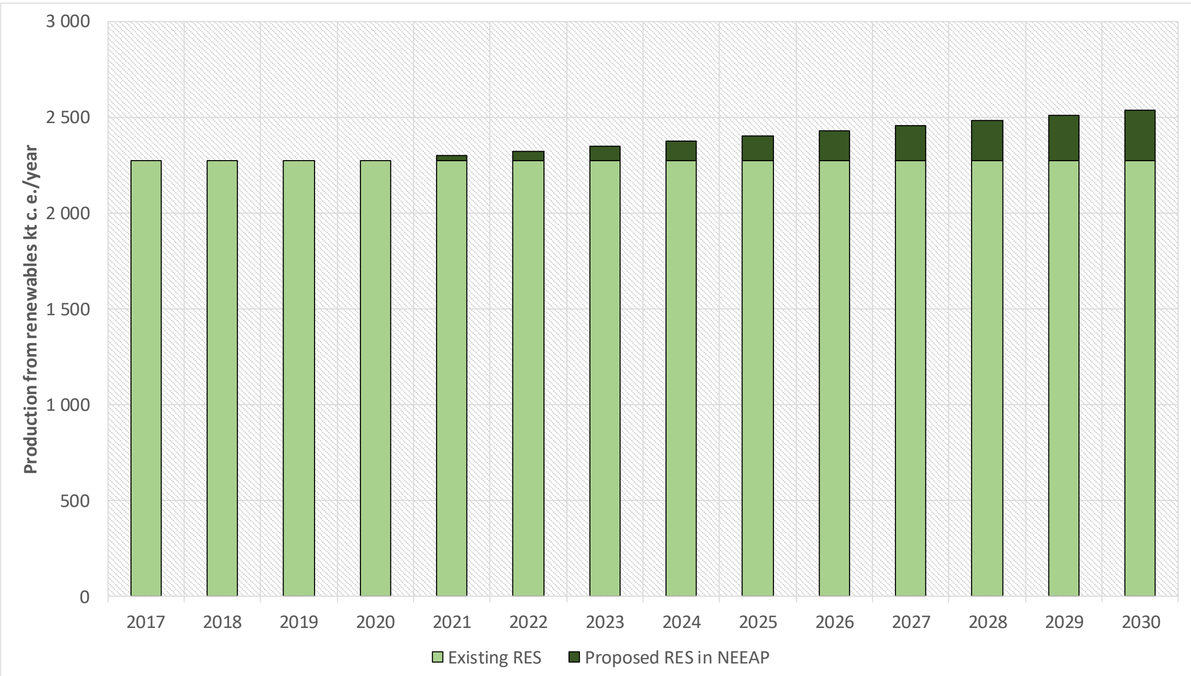
CO_2 savings are based on the conversion factors in the LEAP model (Annex F). The additional investments costs were calculated using a fixed price per kWh (0.1 USD/kWh).

Table 3-37 Financial Incentives for Renewables – production of renewables, CO_2 savings and costs

Period of implementation	2021-2030
Cumulative production of additional renewables above the current level (6.2%)	1,858 kt c.e.
Cumulative CO_2 savings	3,122 kt
Investment costs	3,131 mln. BYN

The diagram below shows the cumulative effect of increasing renewables from the current (2017) level of 6.2% to 8% by 2030.

Figure 3-11 Annual production from renewables in the period 2017-2030 – existing renewables and new proposed in the NEEAP



Clearly the effect on the energy balance of increasing the share of renewables is quite significant, with the cumulative additional production (1,858 kt c.e.) being 9.8% of the cumulative total energy savings from all energy efficiency measures (18,865 kt c.e.).

3.10 Roadmap and Action Plan

The purpose of the NEEAP is to identify policies and measures that have potential to contribute towards the target for 2030 of cumulative energy savings of 11,206 kt c.e. The existing, planned and potential measures are projected to deliver 15,065 kt c.e. of energy savings in 2030 and a consequent reduction in CO_2 emissions of 22,527 kt. Production from additional renewables (to 12%) could contribute the equivalent of 9,965 kt.c.e. of energy supply and a reduction in CO_2 emissions of 16,704 kt.

Table 3-38 Cumulative total energy savings, renewables and CO_2 reduction to 2030

Measures	Cumulative energy savings	Cumulative renewables	Cumulative CO_2 reduction
	[kt c.e.]	[kt c.e.]	[kt]
Existing measures	**12,172**	**250**	**4,737**
Energy efficiency education and training	275	0	468
State ES Programme 2021-2025	9,165	125	2,373
State ES Programme 2026-2030	2,732	125	1,896
Planned measures	**2,448**	**0**	**6,487**
Removing cross subsidies from households	398	0	774
Metering and billing	702	0	1,366
Modernisation of street lighting	162	0	590
The ESCO concept in social sector	109	0	193
Insulation of buildings in the residential sector	796	0	2,790
Waste to energy power plant in Minsk	281	0	774
Potential measures	**4,166**	**399**	**6,983**
Building Renovation Strategy	1,021	0	860
Sustainable Urban Mobility Plans (SUMP)	766	0	1,321
The “Exemplary State” process	66	0	240
Extension of the ESCO Concept	448	0	783
Sustainable Energy and Climate Action Plan (SECAP)	676	214	1,593
Energy Management Systems (EnMS)	379	0	656
Technology and Green Procurement	165	0	285
Nearly Zero Energy Buildings (nZEB)	545	185	1,076
White Certificates trades	46	0	76
Eco-driving for Professional Drivers	54	0	93
Increase in Renewables	**0**	**1,858**	**3,122**
Totals	**18,786**	**2,507**	**21,329**

Roadmap

The Roadmap below contains a framework strategy, including timings for implementation of planned and potential measures.

Table 3-39 Roadmap and Implementation Timescale

Measures	Start year	Validity period									
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Existing measures											
Energy efficiency education and training	2021	●	—	—	—	—	—	—	—	—	►
State ES Programme 2021-2025	2021	●	—	—	—	●					
State ES Programme 2026-2030	2026						●	—	—	—	●
Planned measures											
Removing cross subsidies from households	2021	●	—	—	—	—	—	—	—	—	►
Metering and billing	2021	●	—	—	—	—	—	—	—	—	►
Modernisation of street lighting	2021	●	—	—	—	—	—	—	—	—	►
The ESCO concept in social sector	2021	●	—	—	—	—	—	—	—	—	►
Insulation of buildings in the residential sector	2021	●	—	—	—	—	—	—	—	—	►
Waste to energy plant in Minsk	2022		●	—	—	—	—	—	—	—	►
Potential measures											
Building Renovation Strategy	2021	●	—	—	—	—	—	—	—	—	►
Sustainable Urban Mobility Plans (SUMP)	2021	●	—	—	—	—	—	—	—	—	►
The “Exemplary State” process	2021	●	—	—	—	—	—	—	—	—	►
Extension of the ESCO Concept	2022		●	—	—	—	—	—	—	—	►
Sustainable Energy and Climate Action Plan (SECAP)	2021	●	—	—	—	—	—	—	—	—	►
Energy Management Systems (EnMS)	2022		●	—	—	—	—	—	—	—	►
Technology and Green Procurement	2023			●	—	—	—	—	—	—	►
Nearly Zero Energy Buildings (nZEB)	2025					●	—	—	—	—	►
White Certificates trades	2026						●	—	—	—	►
Eco-driving for Professional Drivers	2026						●	—	—	—	►
Increase in Renewables	2021	●	—	—	—	—	—	—	—	—	►

The starting year of implementation of most planned measures is 2021. Potential new measures will be implemented in a logical sequence to reflect previous activities and required preparatory work. For instance after successful ESCO projects in the social sector, the extension of the ESCO concept could be implemented in 2022. Some measures like Technology and Green Procurement, Nearly Zero Energy Buildings and White Certificates Trades require a longer preparatory phase and therefore implementation is expected after 2023.

Action Plan

The following Action Plan is aimed at implementing the principal measures included in this NEEAP and have been evaluated with the intention to achieve the sustainability objectives required by the NEEAP.

Horizontal measures

- Take into account the investment efficiency of technical measures in the process of preparation the State Energy Saving Programmes for 2021-25 and 2026-2030;
- Expand the ESCO concept to public buildings and buildings in industry (assuming successful implementation in the social sector);
- Seek further IFI support for horizontal measures.

Buildings

- Approve the Building Renovation Strategy (BRS) in the Decree on Energy Efficiency in the Residential sector and develop a BRS that covers all types of buildings;
- Set up a national nearly Zero Energy Building programme and actively promote market uptake of such buildings.

Public sector

- Establish an regularly updated information system of all governmental buildings containing the total floor area of each building and its energy performance;
- Cooperate with the Covenant of Mayors East and their signatories in developing SECAPs and monitoring reports;
- Initiate the “Exemplary State” process. The first step could be including energy efficiency parameters in the public procurement of office equipment.

Industry

- Improve existing monitoring of energy savings and find new energy savings measures in enterprises within their 5-year programmes by implementation of Energy Management Systems (EnMS);
- Establish a preparatory phase for the White Certificates complementary to the State En. Savings Programme;
- Integrate Technology and Green Procurement in the State Energy Savings Programme.

Transport

- Cooperate with city representatives of Polotsk/Novopolotsk and other cities in implementation of SUMPs;
- Decide whether a training in Eco-driving for Professional Drivers will be obligatory and defined by legislation or the training will be on voluntary basis. Consider economic incentives of training courses.

3.11 Investment Costs and Financing of Measures

Investment Costs

The table below shows the investment costs and investment efficiency of the measures in the NEEAP.

Table 3-40 Investment Costs and Investment Efficiency

Measures	Cumulative energy savings	Cumulative renewables	Investment cost	Investment efficiency
	[kt c.e.]	[kt c.e.]	[mln. BYN]	[mln. BYN/kt c.e.]
Existing measures	**12,172**	**250**	**17,309**	**1.4**
Energy efficiency education and training	275	0	4	0.0
State ES Programme 2021-2025	9,165	125	9,282	1.0
State ES Programme 2026-2030	2,732	125	8,023	2.8
Planned measures	**2,448**	**0**	**4 004**	**1.6**
Removing cross subsidies from households	398	0	214	0.5
Metering and billing	702	0	150	0.2
Modernisation of street lighting	162	0	562	3.5
The ESCO concept in social sector	109	0	360	3.3
Insulation of buildings in the residential sector	796	0	2,058	2.6
Waste to energy power plant in Minsk	281	0	660	2.4
Potential measures	**4,166**	**399**	**18,652**	**4.1**
Building Renovation Strategy	1,021	0	2 639	2.6
Sustainable Urban Mobility Plans (SUMP)	766	0	10,000	13.1
The “Exemplary State” process	66	0	0	0.0
Extension of the ESCO Concept	448	0	1,479	3.3
Sustainable Energy and Climate Action Plan (SECAP)	676	214	976	1.1
Energy Management Systems (EnMS)	379	0	819	2.2
Technology and Green Procurement	165	0	97	0.6
Nearly Zero Energy Buildings (nZEB)	545	185	2,518	3.5
White Certificates trades	46	0	110	2.4
Eco-driving for Professional Drivers	54	0	14	0.3
Increase in Renewables	0	1,858	3,131	1.7
Totals	**18,786**	**2,507**	**43,096**	**2.0**

At first sight the total investment cost of 43,096 mln. BYN looks very high. However, on closer examination it is apparent that:

- 17,305 mln. BYN (40%) is attributable to the State Energy Saving Programmes for 2021-2025 and 2026-2030 which would be anticipated without the NEEAP;
- 4,004 mln. BYN (9%) are committed to already planned measures;
- 10,000 mln. BYN (23%) is for Sustainable Urban Mobility Plans (SUMPs) which will be implemented primarily for reasons other than energy saving (such as improving air quality and reducing congestion in cities) and include infrastructure that does not led directly to energy savings;
- 3,131 mln. BYN (7%) is for increased renewables which are separate from the energy saving measures and will be subject to a different decision making process.

This leaves an additional **8,652 mln. BYN** (20%) to be found over 10 years to finance the potential energy saving measures other than the SUMPs.

Apart from the SUMPs the investment efficiency of all of the measures is in the same range as in the current State Energy Saving Programme.

Sources of Finance

Potential Sources of Finance for all of the measures are shown in the following table.

Table 3-41 Potential Sources of Finance

Measures	Potential Sources of Finance				
	Organisation Own Funds/Loans	State Budget	Local Budgets	Private Investor (inc. ESCOs)	International Financial Institutions
Existing measures					
Energy efficiency education and training	X	X			
State ES Programme 2021-2025	X	X	X		X
State ES Programme 2026-2030	X	X	X		X
Planned measures					
Removing cross subsidies from households		X			
Metering and billing	X	X			
Modernisation of street lighting			X	X	X
The ESCO concept in social sector		X		X	X
Insulation of buildings in the residential sector	X	X	X	X	X
Waste to energy power plant in Minsk			X		
Potential measures					
Building Renovation Strategy		X	X	X	X
Sustainable Urban Mobility Plans (SUMP)	X		X	X	X
The “Exemplary State” process		X	X		
Extension of the ESCO Concept		X	X	X	X
Sustainable Energy and Climate Action Plan (SECAP)	X		X	X	X
Energy Management Systems (EnMS)	X			X	
Technology and Green Procurement	X	X	X		
Nearly Zero Energy Buildings (nZEB)	X	X	X	X	X
White Certificates trades	X	X			
Eco-driving for Professional Drivers	X	X	X		
Increase in Renewables	X	X	X	X	X

As is the case with the current State Energy Saving Programme, organisations’ own funds (or loans that they arrange) can be expected to continue to be the predominant source of finance for many of the measures.

Contributions from the State Budget will be required in the majority of measures but will be particularly important in removing cross-subsidies for households (supporting low income households), the Buildings Renovation Strategy (including insulation of residential buildings), nearly Zero Energy Buildings and additional Renewables.

Local Budgets will also contribute to these measures (apart from removing subsidies) but will also be particularly important in the implementation of SUMPs and SECAPs, both of which are developed at the City level.

There is likely to be increased investments from private investors, especially as the ESCO concept becomes more established. ESCOs can be expected to make a significant contribution, especially in the buildings measures but also in street lighting and possibly transport measures under the SUMPs. Private investment in small-scale renewables is also likely if the business case is sufficiently robust.

Finally the IFI’s can be expected to play an increasing role in energy projects in Belarus. EBRD, the World Bank and UNDP are already supporting a number of initiatives and are ready to invest more as the energy saving and renewables programmes develop. Discussions are ongoing with the Belarus government on future financing possibilities.

Although the investment cost for the NEEAP is high, the fact that it is spread over 10 years and across a number of potential financing sources means that the measures in the NEEAP should be affordable and that the Plan is practical and implementable. It is also worth bearing in mind that there are significant further benefits arising from the NEEAP including:

- Substantial CO_2 savings;
- Reduction in imported energy and hence enhanced energy security;
- Increased competitiveness of industry;
- Increased private sector investments;
- Job creation in the energy efficiency and renewables sectors.

All of these are powerful additional arguments for adopting the NEEAP in Belarus.

ANNEX A – BUILDING RENOVATION STRATEGY

The objective of the national building renovation strategy, is to establish long-term confidence in the market, spur investments and increase the renovation rate in Belarus.

The Decree “On improving the energy efficiency of multi-apartment building stock” was approved in (September 2019) in order to reduce the specific heat consumption of the Republic's housing stock, create prerequisites and conditions for organising thermal modernisation of the Republic’s housing stock, attracting funds from a wide range of sources of financing, including homeowners and international financial institutions (World Bank, European Investment Bank, European Bank for Reconstruction and Development, etc.).

The housing fund of the Republic of Belarus currently amounts to 254.4 million square metres, of which multi-family housing stock is about 178 million square meters. Currently, virtually the entire housing stock of the republic (94%) is privately owned. In the conditions of the current trend of gradually increasing the share of owners in the costs of housing maintenance, payment for used heat energy, the key point is to create conditions that encourage them to invest their own funds in modernising their housing and mechanisms for their implementation.

Work on the thermal modernisation of apartment buildings is expected to be carried out in the process of their complex modernisation. At the same time, the main task is to bring the specific heat consumption parameters of each residential apartment building to the corresponding energy efficiency class “B”. This approach will allow an objective approach to solving the problem of reducing the specific heat consumption based on the individuality of residential buildings for heat consumption and the necessary measures to take them.

It is stated in the Decree that the planned thermal modernisation of the housing stock will be carried out with the participation of citizens' funds and that the state will co-finance up to 50% of the total cost.

Funding for activities can be carried out by opening separate accounts in local budgets for the transfer, accumulation, distribution and use of funds for the purpose of improving the energy efficiency of apartment buildings.

Sources of financing the measures may be local budget funds coming from the privatisation of residential premises under the economic or operational management of local executive and administrative bodies in the amount of at least 10% of their total annual volume, local budget funds for complex modernisation of the housing stock in the amount of no more than 10% of the established annual volume, funds of local innovation funds in the amount of not less than 10% of their total annual volume, other sources of financing that are not forbidden under legislation.

In order to involve owners in the implementation of energy efficiency measures, it is planned to use the principle of voluntary participation. At the same time, the decision on the implementation of energy efficiency measures is taken at the general meeting of owners initiated by the local governing body by a qualified majority of their total number - two thirds. A decision made in this way is mandatory for all to execute.

Poor owners of residential premises, who by virtue of their financial situation cannot or find it difficult to make monthly payments in the future, will be subsidised by the State in the aggregate of paid housing and utility services in the framework of the provision of non-cash housing subsidies.

It is estimated that when implementing the thermal modernisation of this part of the housing stock over 10 years, the costs will be about 1,420 million US dollars (the cost of thermo-upgrading does not exceed the equivalent of 50 US dollars per 1 square meter), of which the share of the State will be about 710 million US dollars.

In the first 10 years, heat economy in monetary terms can reach $490 million, including subsidies from the budget of $388 million, including a decrease in natural gas consumption (1.75 billion cubic meters) - about $276.3 million. Taking into account the fact that the buildings will be thermally modernised over a ten-year period, the final savings will be consistently and relatively evenly (taking into account the instalments by the population) by the end of the second decade and will be about $1,380 million (based on the current natural gas tariffs).

With an increase in the level of reimbursement by the population of economically justified costs for the production of thermal energy while reducing the subsidised part of the tariff, investing in thermal modernisation of housing for the population becomes more profitable (the amount of savings increases), which allows the setting of a monthly payment for owners of residential premises in which thermal modernisation is carried out, in a larger amount to ensure cost recovery at the same timescale (10 years).

An important element of the Building Renovation Strategy should be also actions, policies and programmes to increase public awareness to induce behaviour change and support energy efficiency and energy savings in the building sector. In particular, the overall goal of these policies and programmes is to reduce energy consumption mainly through non-technological measures, but also to stimulate technological upgrades.

The information campaigns, awareness-raising and training measures are aimed at changing habitual energy behaviour or investment behaviour of individuals, communities and organisations. Good practices of communication packages and training programs include campaigns that reach end users through many different tools: media campaigns (TV, press, and social media), brochures, guides, conferences and events, web sites, competitions, exhibitions, selected training etc.

All these actions are in line with the Energy Efficiency Directive (2012/27/EU) to enhance the improvement of energy efficiency in order to close the gap between the projected progress and the overall target of reaching the desired reduction of energy consumption.

ANNEX B - NEARLY-ZERO ENERGY BUILDINGS

Introduction

Ambitious requirements for energy performance in buildings are an effective way to foster innovation and achieve a significant reduction of energy use (and GHG), contributing to the energy independence of the country. In order to start up and stimulate increasing numbers of newly constructed energy efficient buildings, implementation of Article 9 of the Energy Performance of Buildings Directive (EPBD, 2010/31/EC) would be very beneficial for Belarus.

Definition

The general definition of nearly-zero energy building (nZEB) is a building with very high-energy performance, where the nearly zero or very low amount of energy required should be extensively covered by renewable sources produced on-site or nearby. Achieving nearly zero-energy demands in new buildings according to the Directive represents an ambitious target of increasing the energy performance of new buildings and simultaneously, it is a target fundamentally affecting public and private life in society. It will require effective planning of investments, objective requirements to secure adequate financial resources, resolution of the necessary forms of financial support, but also, in particular, creation of the legal and technical conditions and appropriate time for design and implementation preparations. Article 9 of the EPBD requires not only setting a national nZEB definition, but also to actively promote a higher market uptake of such buildings. This should be covered by the “National Plan for nZEB” to be developed in accordance with the Directive by 2023.

Technical criteria to achieve nZEB targets

The almost zero or very small quantity of energy required in order to supply these buildings must be secured with effective thermal protection and a high proportion of energy from urban renewable sources in the buildings or their proximity. To achieve the nZEB parameters it is necessary to proceed from the acceptance and determination of three interrelated criteria:

- Reduction of specific heat demand for heating to a minimum. Such a criterion requires a quality design of the building's envelope construction and assumes the use of solar and internal gains.
- Reduction of primary energy consumption for heating, cooling, ventilation, domestic hot water and lighting. The criterion already requires the interconnection of construction and technology. It has an impact on the reduction of the expected consumption of fuels and other forms of energy and better describes the environmental impact of using the building.
- Significant coverage of the overall primary energy demands with urban renewable energy sources. Supply of energy from renewables found in the building or its proximity should provide at least a 50 % reduction of primary energy.

A Road map

A Road map (with clear definitions and measures e.g. policies, standards and financial incentives) to achieve the nearly zero-energy demands in new buildings:

- **Intermediate targets for improving the energy performance of new buildings** - with the existing lack of experience with energy saving construction levels in Belarus progressive steps are required to achieve the final objective and at the required construction energy level. Designers, owners, developers and public authorities must be familiar with stricter energy criteria. There must be time at least for drafting design documentation, issue of building permits and the option of completing the building, whereby its completion may be at a date with stricter requirements for the construction energy level. A realistic estimate of time for completing these procedures is at least three years, even where these deadlines are known in advance and are mandatory.
- **Premises and instruments to increase energy performance in buildings and to prepare for nZEB construction** - one of the basic premises for creating conditions for fulfilling the tasks associated with preparation of nZEB construction is to raise general awareness on the necessity of such construction and to formulate the theoretical preconditions. Informing both the professional and general public requires cooperation with educational institutions, professional organisations, interest groups and the media.
- **Premises for increasing the education level** - the design of nZEB must be based on the fact that the building's conception is changed from a pure energy consumer to one based on used of

renewables. The building's shape, its orientation, quality of thermal insulation of structural, in particular, external elements, glazed windows and adapted technical equipment are all part of the conception of new nZEB. The designer must have detailed knowledge of them and include them in designs by 2025 at the latest.

- **Monitoring and database of buildings owned by public and government authorities** - to understand the energy consumption of buildings occupied by central and local government, public and other authorities requires monitoring of those buildings with the intention of preparing options for their effective renovation. Achieving an annual 1% ratio of renovation of the total floor space of these buildings would allow renovation of buildings with the greatest energy consumption. In order to specify the ratio of renovated buildings it is necessary to identify them along with information on the size of total floor spaces. We propose that Belarus should create such a database by 2022.
- **Efficient use of urban renewables in buildings** – increasing the share of renewables in the generation of electricity and heat with the objective of creating adequate additional sources required to cover domestic demand is one of the basic priorities defined in the Concept of Energy Security of Belarus until 2035. The growth in prices of fossil non-renewable fuels in recent years force this energy alternative into the economic and political aspect. Renewables which are currently technologically feasible to use for electricity, heat generation and transport fuels are biomass (incl. biofuels and biogas), solar, hydroelectric, wind and geothermal energy. Construction of buildings to meet nZEB criteria will require use of urban renewables. In the coming period it will be necessary to prepare an analysis of the effective use of RES for each energy consumption point and with emphasis on the building category. Involvement of public administration in increasing energy efficiency and use of renewables is also supported by the Covenant of Mayors.
- **Promoting an increase in energy performance in buildings and changeover to nZEB construction** - the objective of financial aid will be, above all, to adapt existing financial instruments to increase investment into energy performance in buildings and to seek new forms in view of the potential within the national budget. This process must be continuous and must react to development in the area of construction. It will be oriented to the use of private-public partnerships, promotion of ecological technologies and energy efficient systems, revision of construction processes and use of more energy efficient construction products.

Potential savings

Fulfilment of the progressive steps to achieve the target in 2025 represents a reduction of the energy demands of buildings. Therefore, it is necessary to get an idea of the potential energy savings.

It covers the potential energy savings in the construction of new buildings in the given time period taking account of the tightening up of criteria for construction. The expected period of calculated savings is up to 2030, i.e. including the phase of construction of nearly zero-energy buildings. Other premises used in the calculation are based on statistical findings, which assume an annual construction of 15,000 dwellings in single-family houses and apartment blocks and 110 office buildings. Based on the given premises and calculations an energy saving of about 1.5 PJ can be achieved, which represents a CO_2 emission reduction of 87,000 tons.

Improving energy performance is a current, though not new theme. Research and development tasks were elaborated in the past to support this area resulting in conceptual and legislative instruments. The trend in this area is clearly toward reduction of energy consumption. The creation of the conditions for meeting the targets for the construction of nearly zero-energy buildings requires the drafting of new legislation, updating of the concept and tightening of the requirements laid down in technical standards.

ANNEX C - LEAP MODEL

The LEAP model divides the energy system into three obligatory blocks – demand, transformation and resources. The resources block describes availability of non-renewable, renewable and secondary energy carriers. The transformation block deals with all transformation technologies (power plants, heating plants, refineries etc.) and transmission and distribution networks. The demand block serves for modelling of energy demand of various energy end users and of end user energy technologies. More detailed structure within these three blocks and lists of used technologies and energy carriers depend fully on the model user.

Key drivers

LEAP is mainly a simulation model (with some optimising capability of the power system) and it tries to satisfy the energy needs of end users utilising available energy sources and transformation technologies. Hence, the main drivers influencing the energy system act in the demand block. The selected split of energy demand introduces the classical sectors – agriculture, industry and construction, services (public and commercial together), households and transport. The list of key drivers comes from modelling the needs of selected sectors. The model uses the following key drivers:

Population and derived drivers

The population statistics come from Demographic Yearbooks published by the National Statistical Committee of the Republic of Belarus. The projection of population follows the figures from the World Bank's database "Population estimates and projections"[46].

Population serves as a key driver for the following purposes:

- Calculation of energy consumption for water heating in households.
- Together with unit living area per person for calculation of energy consumption for space heating in households. The National Statistical Committee of the Republic of Belarus publishes statistics of total floor area and of floor area per person[47] in urban and rural areas. Population projections and extrapolation of floor area per person served for calculation of the heated floor area. Another extrapolated factor that came into consideration was the movement of population from rural to urban areas.
- Together with persons per dwelling for calculation of number of dwellings and afterwards of energy consumption of all other energy uses than space and water heating in households. The projection of persons per dwelling used the assumption of 0.5% annual decrease.

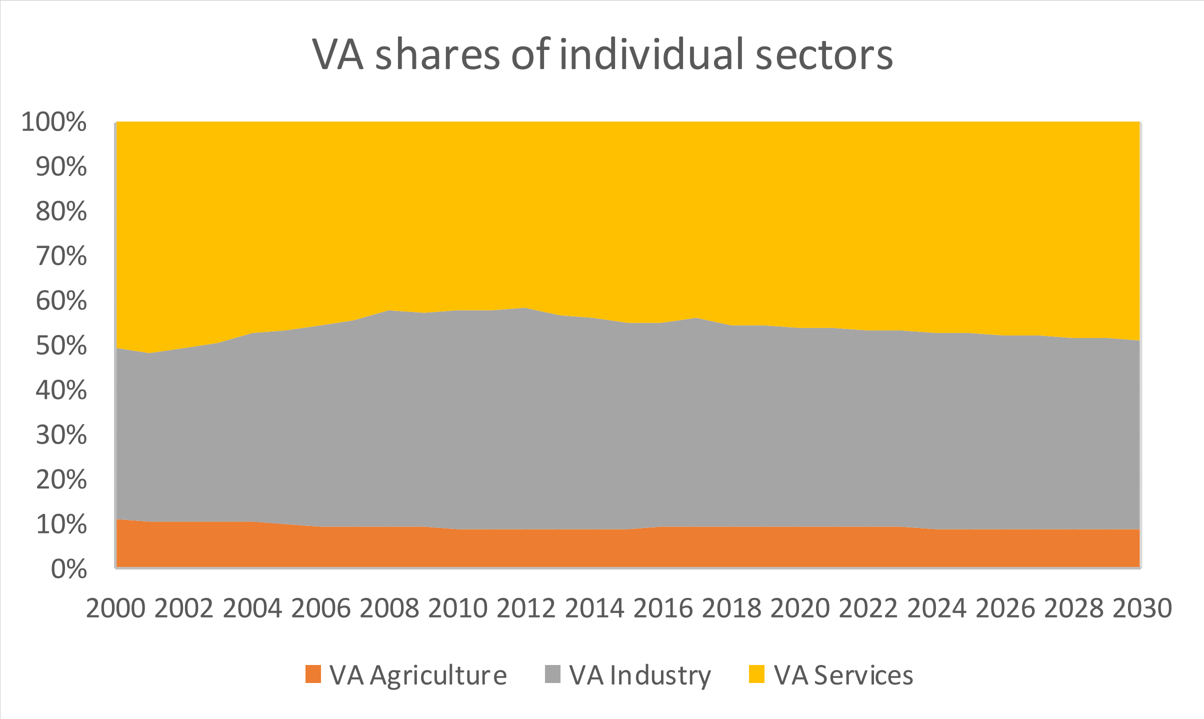
GDP and value added

The GDP and VA statistics (in constant prices and national currency) comes from the World Bank's database "World Development Indicators"[48]. The projection of GDP assumes an annual growth of 3%.

GDP itself does not act as driving variable but it is used for deriving the projection of total value added using the same growth rate of 3%. The total VA was further split into VAs of agriculture, industry and construction and services using extrapolation of VA shares of individual sectors (see the following diagram).

[46] https://databank.worldbank.org/data/source/population-estimates-and-projections
[47] http://www.belstat.gov.by/en/ofitsialnaya-statistika/social-sector/zhilischnye-usloviya/
[48] https://databank.worldbank.org/data/source/world-development-indicators

Figure C1 Value added shares of individual sectors



Derived values added drive the energy consumption in the above three sectors.

Transport drivers

Lack of suitable statistical data does not permit to use traditional tonne-kilometres and person-kilometres as key transport drivers. Therefore, the energy consumption of the transport sector is driven by the total value added instead.

Demand sector

Agriculture

There is no information on the split of energy consumption by energy uses. Since no energy saving measures are proposed for this sector, the agriculture model is simple. The energy consumption is derived from VA of agriculture sector and energy intensities of individual energy carriers.

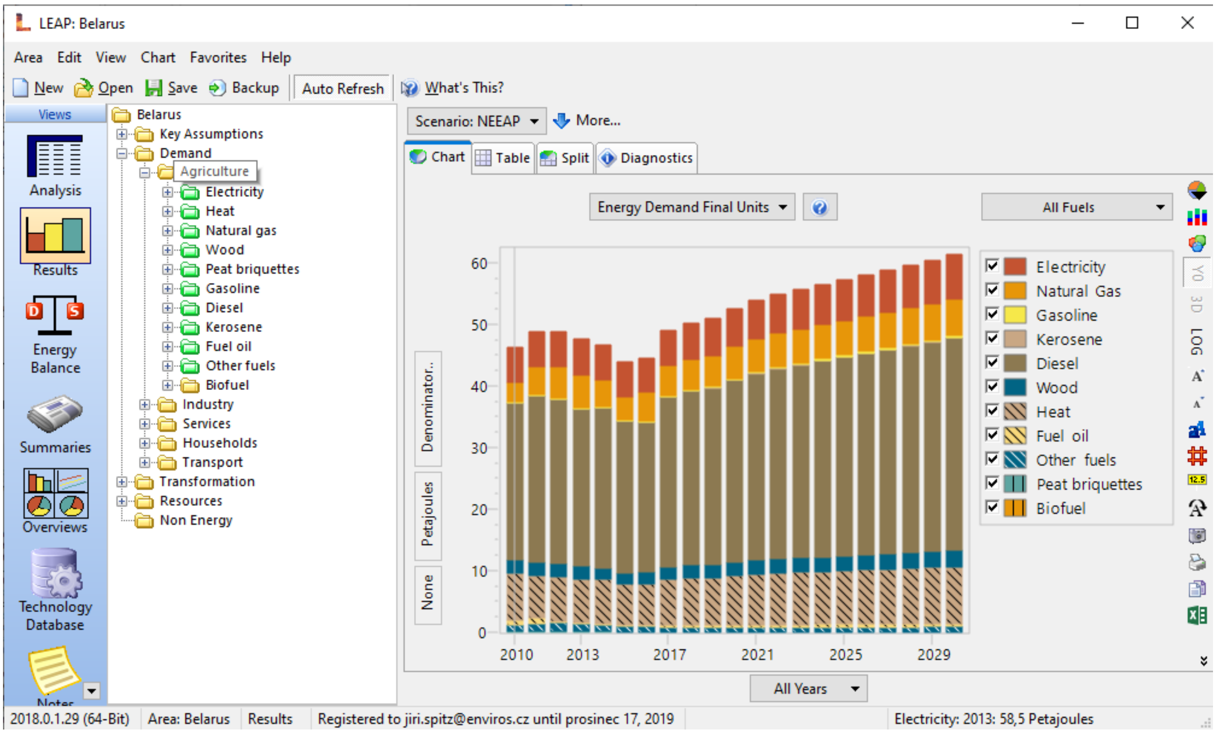
The Figure C2 presents the model structure of agriculture together with chart of its final energy consumption. Consumption $W_{c,t}$ of each energy carrier c in the year t is calculated following the formula

$$W_{c,t} = w_{c,t} * VA_{agr,t} \text{ [GJ], where}$$

$w_{c,t}$ Energy intensity of agriculture for the energy carrier c and in the year t [GJ/BYN]

$VA_{agr,t}$ Value added of agriculture in the year t [BYN].

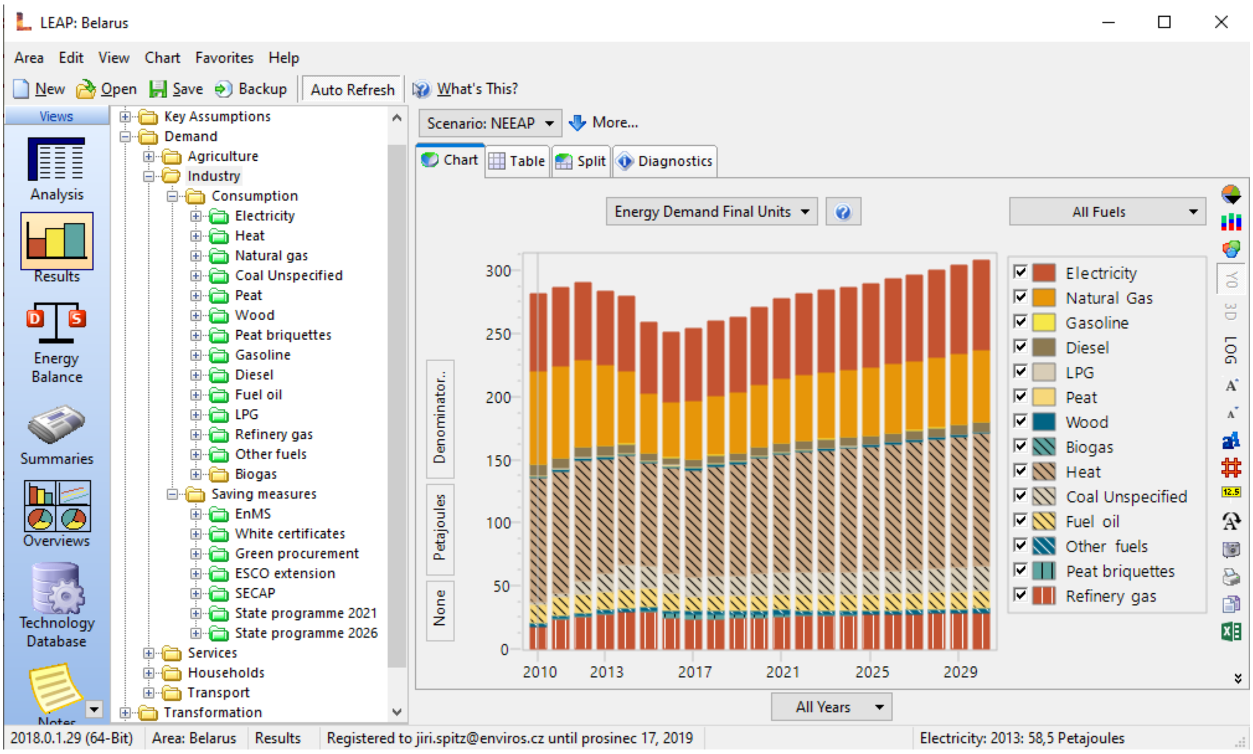
Figure C2 Final consumption of agriculture sector (scenario NEEAP)



Industry

Similarly to agriculture, the breakdown of energy consumption by energy uses is not available. The energy consumption is calculated again as a product of VA of industry and energy intensities. The energy saving measures are calculated simply as improvements of energy intensities.

Figure C3 Final consumption of industry sector (scenario NEEAP)



The Figure C3 presents the model structure of industry together with chart of its final energy consumption. Consumption $W_{c,t}$ of each energy carrier c in the year t is again calculated following the formula:

$$W_{c,t} = w_{c,t} * VA_{ind,t},$$ [GJ] where

$w_{c,t}$ Energy intensity of industry for the energy carrier c and in the year t [GJ/BYN]

$VA_{ind,t}$ Value added of industry in the year t [BYN].

There is a separate branch for energy saving measures in the tree structure. The energy savings are calculated according to the formula shown above, but with negative energy intensities.

Services

Since there is no statistical information on energy consumption breakdown by energy uses, the modelling of service sector is simplified to a breakdown by energy carriers and in final energy terms only. The projection of energy consumption stems from expected development of value added of the sector. Only three options are defined for the service sector:

- Old buildings – no changes in energy intensity are supposed.
- Refurbished buildings – expected energy consumption reaches 55% of that of old buildings
- nZEBs – expected energy consumption reaches 26 - 28% of that of old buildings, part of electricity and heat consumption is covered by solar installations

The energy consumption of services by energy carriers comes from official energy balances. The energy intensity improvements were estimated using the experience from the Czech Republic.

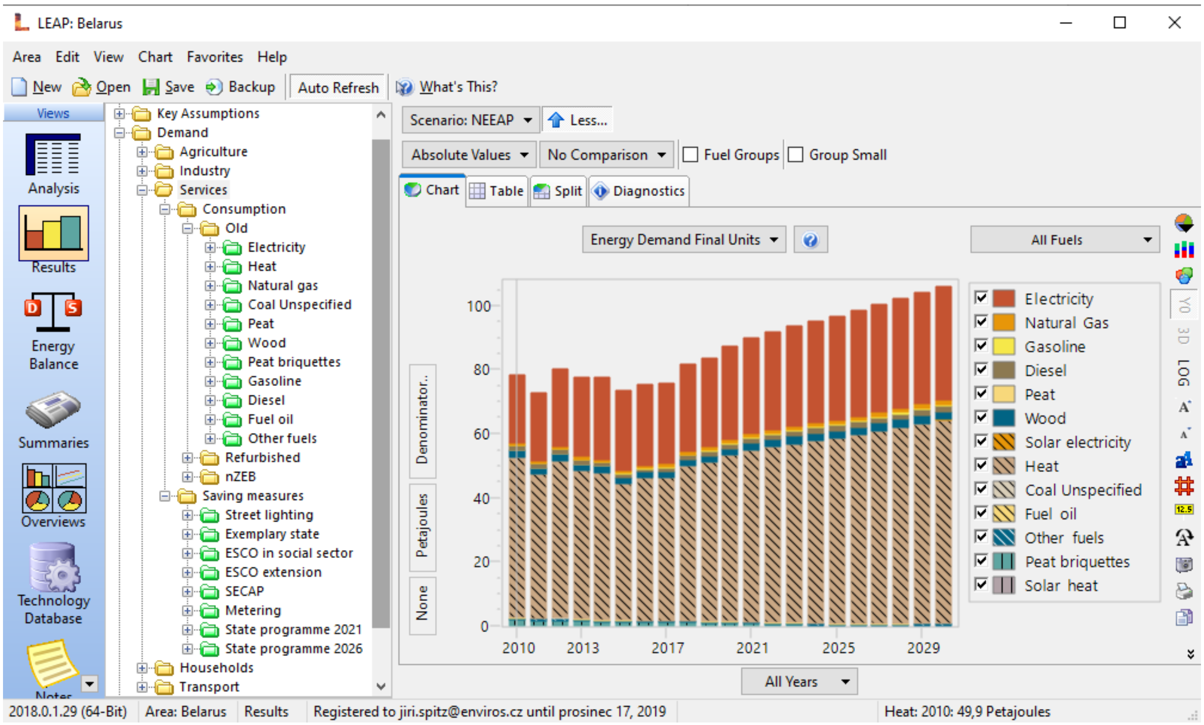
The Figure C4 presents the model structure of services together with chart of its final energy consumption. Consumption $W_{c,t}$ of each energy carrier c in the year t is again calculated following the formula

$$W_{c,t} = w_{c,t} * VA_{ser,t},$$ [GJ] where

$w_{c,t}$ Energy intensity of services for the energy carrier c and in the year t [GJ/BYN]

$VA_{ser,t}$ Value added of services in the year t [BYN].

Figure C4 Final consumption of service sector (scenario NEEAP)



There is again a separate branch for energy saving measures in the tree structure. The energy savings are calculated according to the formula shown above, but with negative energy intensities.

Households

Residential buildings were categorised as follows:

- By location
  - Urban houses
  - Rural houses
- By energy insulation standard
  - Buildings built before 1993
  - Buildings built in the period 1993 – 2009
  - Buildings built after 2009
  - Refurbished buildings
  - Near zero energy buildings (nZEB)

Historical data for the mentioned categories came from statistics of the construction sector. The projection of future development results from:

- Projection of the population.
- Projection of number of persons per dwelling based on extrapolation of the current trend. It reflects the trend that the number of persons in one flat gradually decreases.
- Extrapolation of the trend in moving population from rural areas into cities.

The projection takes into consideration also the average demolition rate. It was derived from the difference of construction of new buildings and statistics of total occupied buildings. Demolition rate for rural buildings is quite high because it reflects the decrease of population in rural areas.

The business as usual (BAU) scenario reflects all new construction from 2020 to be aligned with the standard of buildings built after 2009. The modelled saving measures can then introduce various shares of refurbished houses and nZEBs.

Energy consumption of households was split into three segments:

- Consumption depending on number of dwellings – energy consumption for cooking, electricity consumption for lighting and electricity consumption of appliances. Energy consumption of this segment is calculated in terms of final energy. Assumptions for energy saving measures modelling:
  - Refurbished houses – refurbishment will have no impact on this part of energy consumption
  - nZEBs – part of electricity consumption will be covered by photovoltaic panels.
- Consumption depending on number of persons – energy consumption for water heating. Energy consumption of this segment is calculated in terms of useful energy taking efficiencies of boilers into consideration. Assumptions for energy saving measures modelling:
  - Refurbished houses – the boilers will be replaced with more efficient ones, no new boilers using peat will be installed
  - nZEBs – the boilers will be replaced with more efficient ones, no new boilers using peat will be installed, and part of energy consumption for water heating will be covered by solar panels.
- Consumption depending on the size of flats measured in m^2 – energy consumption for space heating. Energy consumption of this segment is calculated in terms of useful energy as well. Assumptions for energy saving measures modelling:
  - Refurbished houses – the buildings will undergo a complex refurbishment leading to better thermal insulation, the boilers will be replaced with more efficient ones, no new boilers using peat will be installed
  - nZEBs – the buildings will be built in the nZEB standard (insulation, efficiency of boilers), no new boilers using peat will be installed, and part of energy consumption for space heating will be covered by heat pumps and solar panels.

The following table shows the used relations of energy intensities in individual types of buildings relative to the oldest ones:

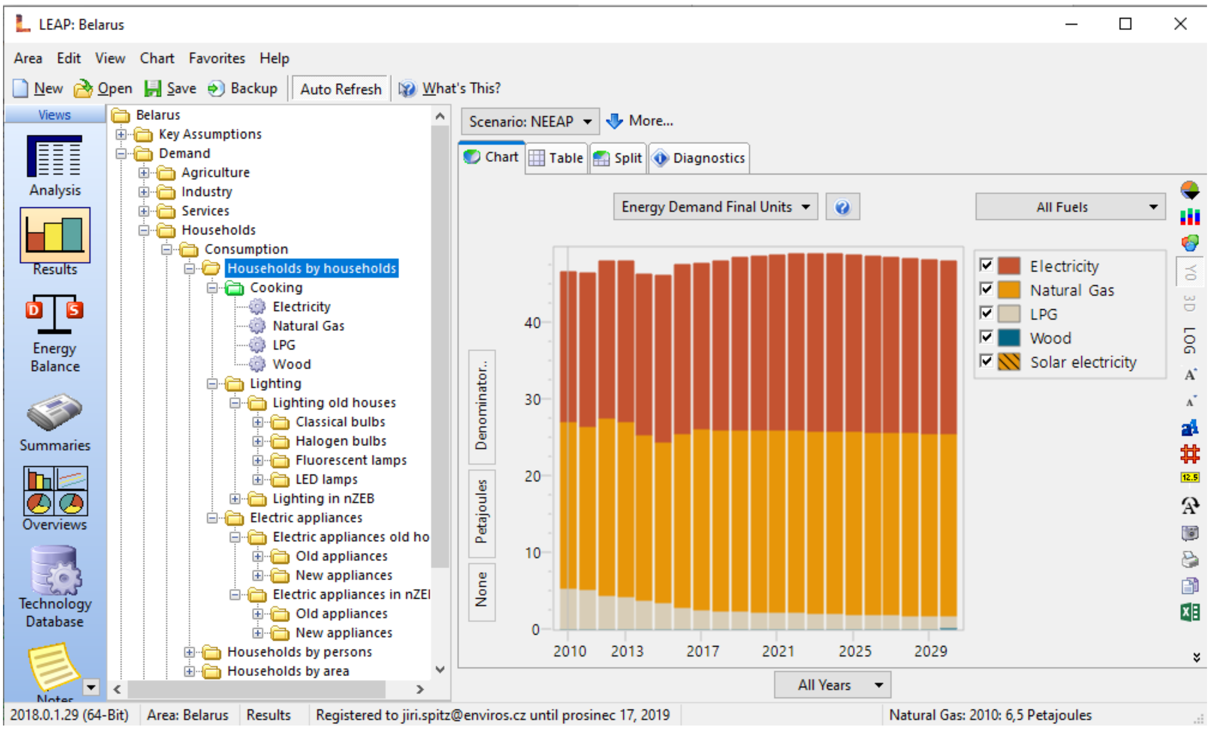
The following table shows the used relations of energy intensities in individual types of buildings relative to the oldest ones:

Table C1 Relations of energy intensities in individual types of buildings

	Urban houses	Rural houses
Buildings built before 1993	100%	100%
Buildings built in the period 1993 – 2009	65%	65%
Buildings built after 2009	35%	35%
Refurbished buildings	55%	55%
Near zero energy buildings (nZEB)	28%	26%

The breakdown of energy consumption by energy uses and energy carriers is based on the results of the energy survey of households from 2015 and official energy balances (Belstat).

Figure C5 Final consumption of households sector – part depending on number of dwellings (scenario NEEAP)



Energy consumption depending on number of dwellings is calculated as follows.

Cooking

$$W_{c,t} = w_{c,t} * N_{dwell,t} * s_{c,t}, \text{ where}$$

$W_{c,t}$ Final energy consumption of energy carrier c in the year t [GJ.y^{-1}]

$w_{c,t}$ Energy intesity of cooking by energy carrier c in the year t [GJ.dwell^{-1}.y^{-1}]

$N_{dwell,t}$ Number of dwellings in the year t [1]

$s_{c,t}$ Share of dwellings using energy carrier c for cooking in the year t [1]

Lighting

$$W_{b,t} = w_{b,t} * N_{dwell,t} * s_{b,t}, \text{ where}$$

$W_{b,t}$ Final energy consumption of electricity by bulb type b in the year t [GJ.y^{-1}]

$w_{b,t}$ Energy intesity of lighting by bulb type b in the year t [GJ.bulb^{-1}y^{-1}]

$N_{dwell,t}$ Number of dwellings in the year t [1]

$s_{b,t}$ Share of bulbs of type b in the year t [1]

Electric appliances

$$W_{a,h,t} = w_{a,h,t} * N_{dwell,t} * s_{h,t} * s_{a,h,t}, \text{ where}$$

$W_{a,h,t}$ Final energy consumption of electricity by appliance type a (old/new) in house type h (old buildings/nZEBs) in the year t [GJ.y^{-1}]

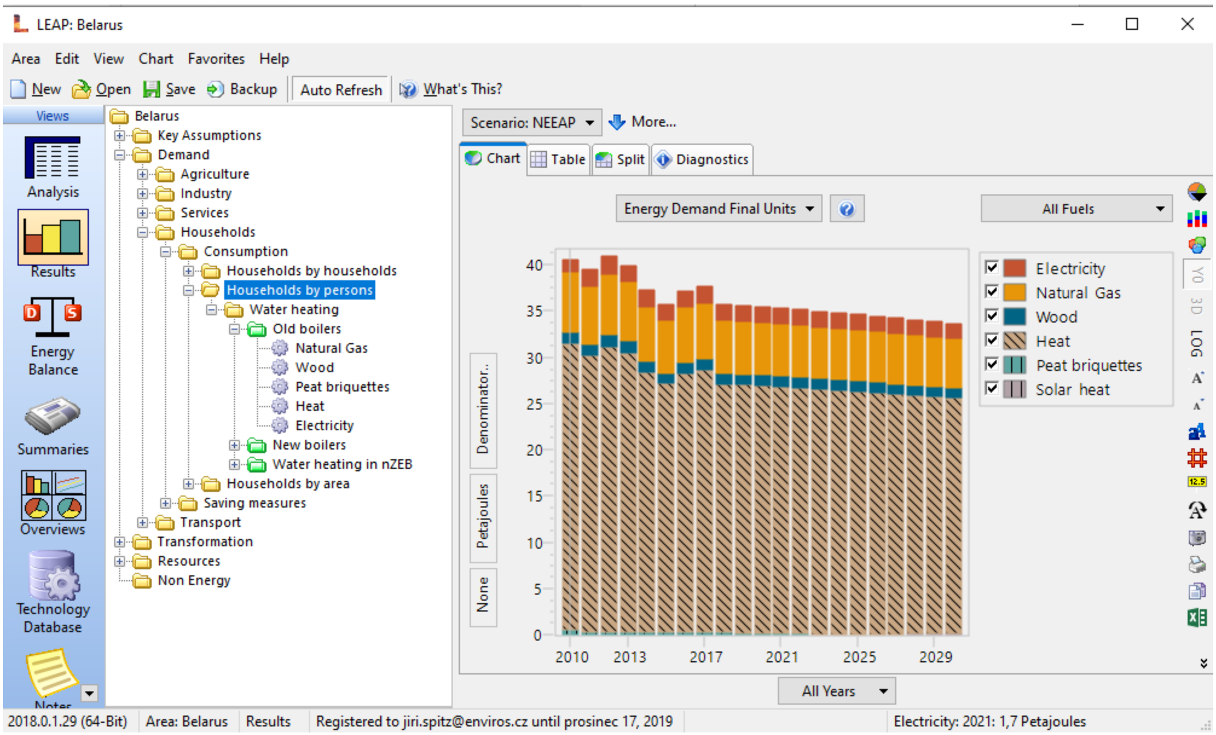
$w_{a,h,t}$ Energy intensity of appliance type a (old/new) in house type h (old buildings/nZEBs) in the year t [GJ. dwell^{-1}.y^{-1}]

$N_{dwell,t}$ Number of dwellings [1]

$s_{h,t}$ Share of houses of type h (old buildings/nZEBs) in the year t [1]

$s_{a,h,t}$ Share of appliances of type a (old/new) in houses of type h (old buildings/nZEBs) in the year t [1]

Figure C6 Final consumption of households sector – part depending on number of persons (scenario NEEAP)



Energy consumption depending on number of persons is calculated as follows.

Water heating

$$W_{b,c,t} = w_t * N_{pers,t} * s_{c,t} * \eta_{b,c,t} * s_{b,t}, \text{ where}$$

$W_{b,c,t}$ Final energy consumption of energy carrier c by boiler type b (old/new/in nZEBs) in the year t [GJ.y^{-1}]

w_t Energy intensity of water heating in the year t [GJ.person^{-1}.y^{-1}]

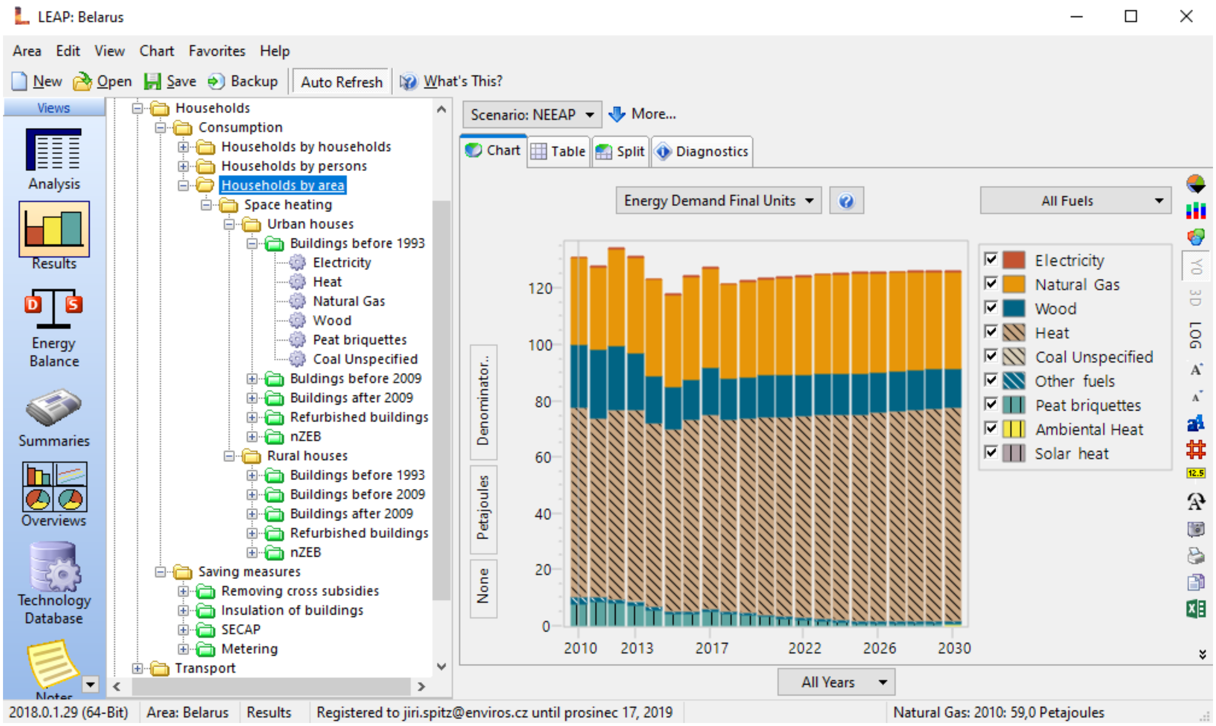
$N_{pers,t}$ Number of persons [1]

$s_{c,t}$ Share of houses with boilers using energy carrier c in the year t [1]

$s_{b,t}$ Share of boilers of type b (old/new/in nZEBs) in the year t [1]

$\eta_{b,c,t}$ Energy efficiency of boilers of type b (old/new/in nZEBs) using energy carrier c in the year t [1]

Figure C7 Final consumption of households sector – part depending on living area of flats (scenario NEEAP)



Energy consumption depending on living area of flats is calculated as follows.

Space heating

$$W_{a,b,c,t} = w_{a,b,t} * A_t * s_{a,t} * s_{a,b,c,t} * \eta_{a,b,c,t} * s_{a,b,t}, \text{ where}$$

$W_{a,b,c,t}$ Final energy consumption of energy carrier c in building type b (construction year or nZEB) in area a (urban/rural) in the year t [GJ.y^{-1}]

$w_{a,b,t}$ Energy intensity of space heating in building type b (construction year or nZEB) in area a (urban/rural) in the year t [GJ.m^{-2}.y^{-1}]

A_t Living area of all houses in the year t [m^2]

$s_{a,t}$ Share of living area in area of type a (urban/rural) in the year t [1]

$s_{a,b,t}$ Share of area in buildings of type b (construction year or nZEB) in area of type a (urban, rural) in the year t [1]

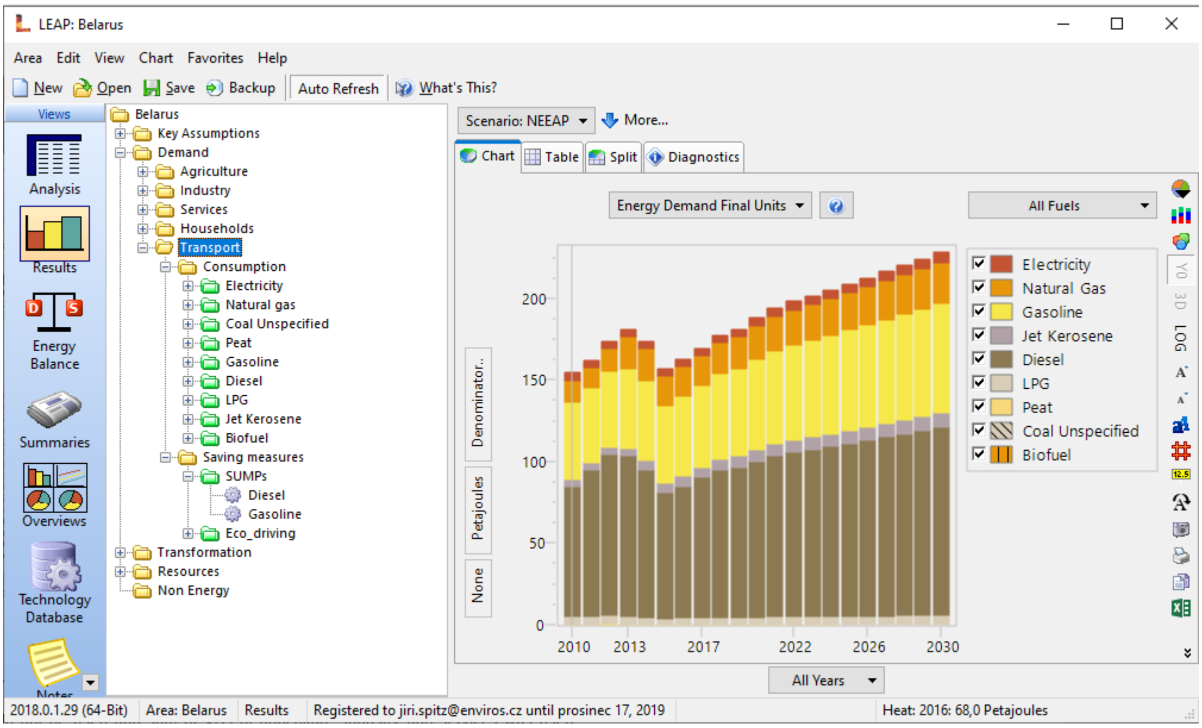
$s_{a,b,c,t}$ Share of boilers using energy carrier c in buildings of type b (construction year or nZEB) in area of type a (urban, rural) in the year t [1]

$\eta_{a,b,c,t}$ Energy efficiency of boilers using energy carrier c in buildings of type b (construction year or nZEB) in area of type a (urban, rural) in the year t [1].

Transport

Detailed statistics on transportation outputs and related energy consumption exists only for transport performed by organisations that belong to the transport sector. There are no statistics on transportation outputs of private vehicles (not only cars, but also non-negligible number of buses and trucks) and of vehicles operated by industries and services. Thus, the most suitable drivers – person-kilometres and ton-kilometres – could not be used and sum of VAs of agriculture, industry and services was used instead. The energy consumption is calculated as a product of the total VA and energy intensities. Saving measures are then modelled as fuel switches and improvements of energy intensities.

Figure C8 Value added shares of individual sectors



The Figure C8 presents the model structure of transport together with chart of its final energy consumption. Consumption $W_{c,t}$ of each energy carrier c in the year t is calculated following the formula

$$W_{c,t} = w_{c,t} * (VA_{agr,t} + VA_{ind,t} + VA_{ser,t}),\ \text{[GJ] where}$$

$w_{c,t}$ Energy intensity of transport for the energy carrier c and in the year t [GJ/BYN]

$VA_{agr,t}$ Value added of agriculture in the year t [BYN]

$VA_{ind,t}$ Value added of industry in the year t [BYN]

$VA_{ser,t}$ Value added of services in the year t [BYN].

Transformation sector

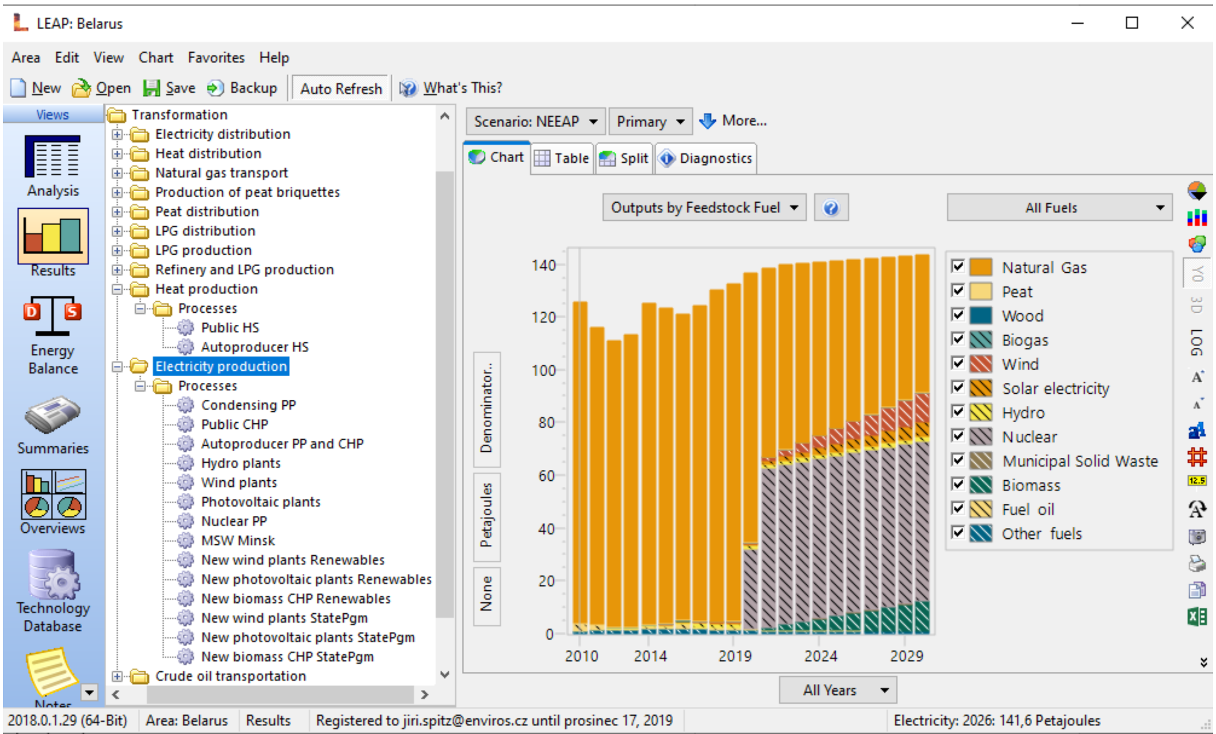
The Transformation sector is divided into the blocks described below.

Electricity and heat generation blocks

Power plants and heating plants constitute the main part of the transformation sector. The model splits power and heat generation into two subsectors. The first one models single product electricity plants and combined heat and electricity plants, the second one deals with single product heating plants. With respect to limited availability of statistical data, the model does not calculate with individual power and heating plants. The model contains groups of power and heating plants as published in the official energy statistics instead. The breakdown is as follows:

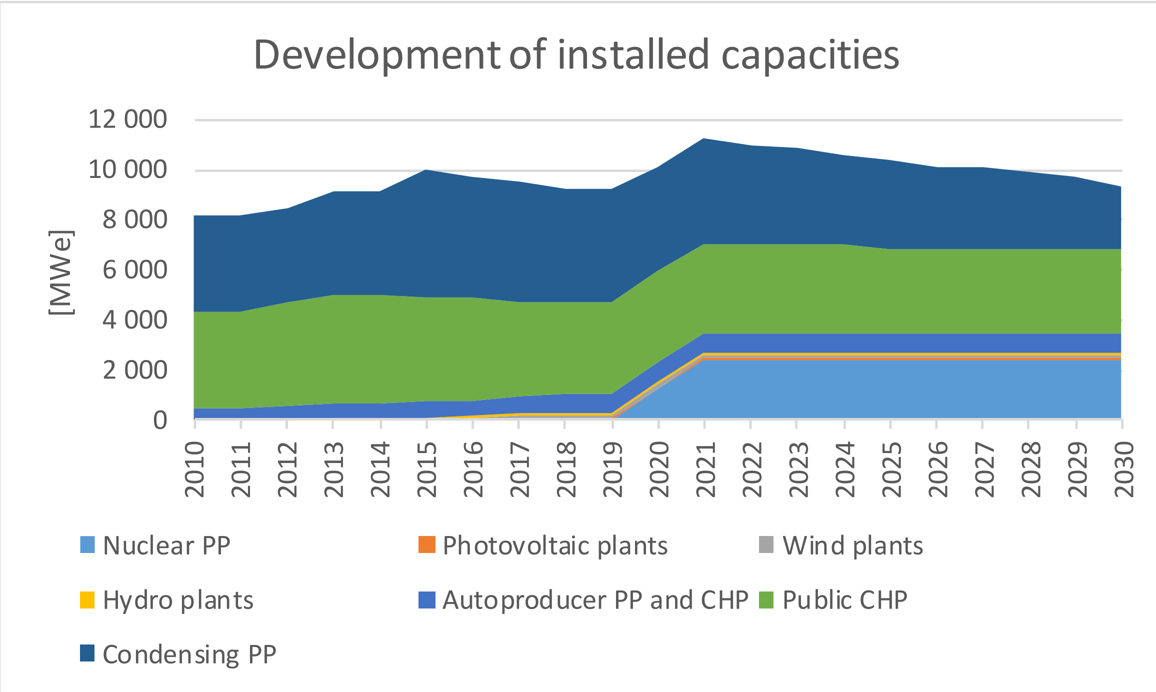
- Power and combined heat and power plants
  - Public condensing power plants
  - Public CHP plants
  - Autoproducer's power plants and CHP plants
  - Nuclear power plant
  - Hydropower plants
  - Wind plants
  - Photovoltaic plants.
- Heating plants
  - Public heating plants
  - Autoproducer's heating plants.

Figure C9 Electricity production by used input energy carriers



The statistics on power and heat generation and installed capacities come from the energy balances. As regards projections of installed capacities, precise figures and years of commissioning were available only for the new nuclear power plant. Only total planned new and decommissioned capacities without year specifications were given for the other power plants, so the changes are split more or less linearly during the period 2020 – 2030. The following graph presents the development of installed capacities.

Figure C10 Development of installed capacities



Since there is no precise information on installed capacities of heating plants, the values from the year 2017 were retained for the whole period up to the year 2030.

The power plants are modelled with installed output capacities and using the following dispatch rules:

- Nuclear power plant, hydropower plants, wind plants and photovoltaics plants use "full capacity" rule. That means the model tries to utilise their installed capacities up to the given capacity factor.
- All condensing and combined heat and power plants use "proportional to capacity" rule. That means the model allocates the power production to them in shares equal to mutual shares of their installed capacities.

The model calculates with net energy efficiencies and explicit own electricity consumptions for all thermal power plants.

Electricity and heat transmission and distribution blocks

Blocks of electricity and heat transmission and distribution networks serve solely for modelling of electricity and heat losses as a percentage of the transported energy.

Natural gas transport block

Natural gas transport block models natural gas losses and mainly the energy required for gas transport from Russia, again as a percentage of the transported amount of gas.

LPG production block

LPG has two sources – oil refinery and a separate technology for LPG production. Due to lack of detailed energy balances of processes of oil refinery and LPG production, all LPG production is modelled within the oil refinery process.

LPG distribution block

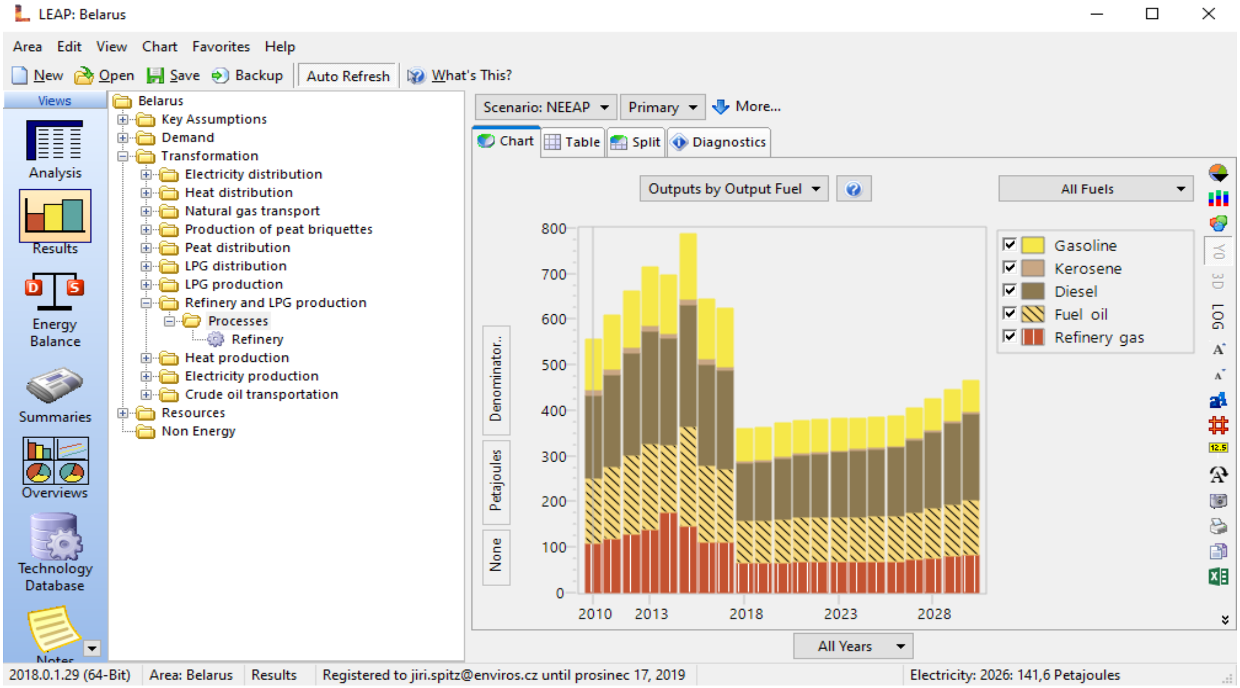
LPG distribution block simply calculates losses during LPG transport as a percentage of the transported amount of LPG.

Oil refineries

There are two oil refineries in the Republic of Belarus. Statistical data on oil refining come from two sources – yearbooks Energy Balances of the Republic of Belarus and energy balances in the Eurostat format for years 2016 and 2017. The first source lacks sufficiently detailed data on oil refining. The second data source is more detailed but the data seem to be questionable – the refineries have an efficiency of 100% and the balances show huge crude oil losses. The model of oil refineries describes the oil refining as one process only. The description combines two mentioned data sources and it also utilises energy balances from the IEA. However, some expert estimates had to be done.

As the oil refineries have multiple output fuels and the LEAP model allows only fixed shares of output fuels, it is problematic to model correspondence of refineries outputs and changing demand for individual fuels. Thus, the model utilises imports and exports of oil products instead of adaptation of refinery production to changes in demand for oil products.

Figure C11 Outputs from the oil refining process (NEEAP scenario)



The Figure C11 shows the results of problematic modelling of oil refineries. Data for years 2010 – 2017 come from statistics. Data after the year 2017 suffer from exogenously given shares of output energy carriers. The shortages and surpluses of oil products are solved by imports and exports.

Peat briquettes production block

According to available energy balances, production of peat briquettes is modelled as a process with given efficiency without any additional input energy carriers other than peat.

Peat distribution block

Peat distribution block simply calculates losses during peat transport as a percentage of the transported amount of peat.

Energy carriers

The selection of energy carriers for the model reflects the structure of available energy balances. The model comprises the following energy carriers:

- Electricity
- Heat
- Fossil fuels
  - Natural gas
  - Crude oil
  - Gasoline
  - Diesel
  - LPG
  - Fuel oil
  - Refinery gas
  - Jet kerosene
  - Unspecified coal
  - Peat and peat briquettes (supposing that no peat and peat products will be used after the year 2025 as proposed by MinNREP)
  - Other fuels
- Biomass
  - Liquid biofuels for transport
  - Fuel wood
  - Biogas

- Renewables
  - Solar heat
  - Solar electricity
  - Hydro power
  - Ambient heat (for heat pumps).

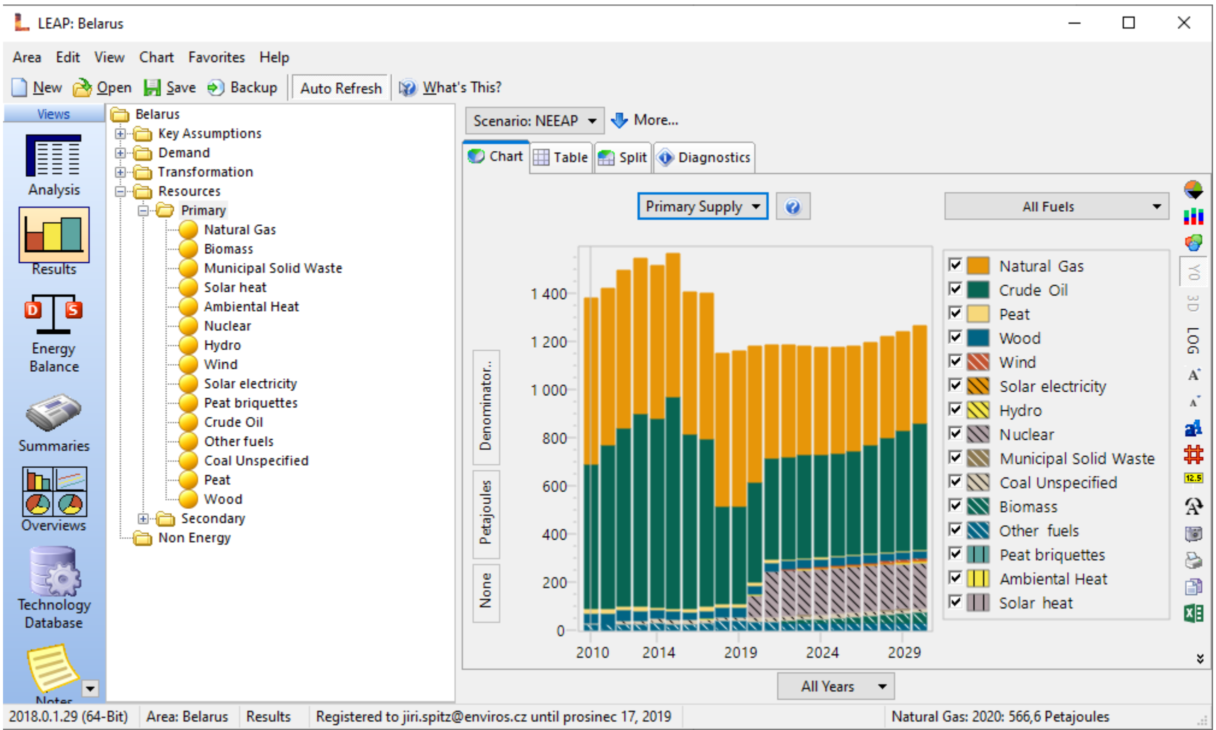
Energy resources

The energy supply in the Republic of Belarus depends mostly on imports. There is a negligible domestic production of crude oil and natural gas. Non-negligible is mining and use of peat. However, due to environment protection reasons, mining of peat is supposed to be reduced in the few next years. Thus, the only long-term prospective domestic fuel remains biomass. The model reflects the availability of energy sources as follows:

- Crude oil and other oil products can be imported without explicit limits. Surplus oil products can be exported but domestic use is preferred.
- Natural gas can be imported without explicit limits.
- Shortages of electricity can be imported without explicit limits, surplus electricity can be exported but domestic use is preferred.
- Use of peat will be gradually discontinued until the year 2025, when it will cease.
- Nuclear fuel will be imported without explicit limits.
- There is limited potential for new hydropower power plants (mainly small-scale systems)
- Utilisation of solar and ambient energy has currently no explicit limits.
- Biomass availability is not currently limited; in the case of modelling more ambitious programmes of its use, its availability might be limited.

Since the block of transformation technologies of the current model version does not use any dispatch rules based on costs, the energy resources do not carry information on prices.

Figure C12 Primary energy supply (NEEAP scenario)



The list of primary energy carriers (Figure C12) is automatically generated by the model and the chart shows the calculated primary energy supply.

ANNEX D - EXAMPLES OF ENERGY EFFICIENCY OBLIGATION SCHEMES

Monitoring and evaluation of energy efficiency obligation schemes (EEOS) and alternative policy measures adopted by EU Member States show that almost all have opted for alternative measures: 24 out of 28 MS have relied exclusively on alternative measures or a combination of alternatives with an obligation scheme. The reason for that is the high degree of flexibility of a variety of alternative measures to opt for as well as increased familiarity, since all MS countries have already implemented similar schemes.

The map below presents the current status of implementation of obligation schemes across the EU:

Figure D1 Overall assessment of MS options to achieve savings

Source: Article 7 EED platform[49] ; EEO = Energy Efficiency Obligation scheme

Only four countries opted for an EEOS only: Bulgaria, Denmark, Luxembourg and Poland. Nine countries opted for alternative measures, and 14 countries for a combination of measures.

Examples in the EU include:

Poland – White certificates (used also in Italy, France and other countries alongside alternative measures)

Energy companies selling electricity, heat or natural gas to final consumers are required to comply with a statutory obligation to complete an energy efficiency project at a final consumer, or generate and present to the President of the Energy Regulatory Office (URE) for redemption a specific amount of final energy savings, as confirmed by a certificate (white certificate). Alternatively, the above obligation can be met by the payment of a compensation fee subject to specific conditions, in which case the proceeds from the fee are allocated for delivering energy efficiency projects at end users, and the entity which manages the revenues from the fee is required to report the amount of funds earmarked for the delivery of such projects and the final energy savings realised to the Minister of Energy.

[49] http://www.article7eed.eu/index.php/article-7-insight/eu-outlook

Denmark – mainly advice and subsidies (adopted by Luxembourg as well)

Denmark has had energy efficiency obligations since 2006. The obligations are enshrined in the electricity supply, natural gas supply and heat supply acts for electricity grid companies, natural gas distribution companies and district heating companies. There is therefore a legal basis for imposing an annual energy efficiency obligation on these companies, although in practice the action is implemented through an agreement with the sectors/companies concerned. The obligated parties' involvement can take various forms. It might take the form of advice or a grant to the final customer, or indeed a combination thereof. Examples of activities include improved insulation or the installation of more energy-efficient windows. Energy efficiency improvements in terms of the energy consumption of industry also fall within this category. Replacing old energy-efficient boilers with new high-efficiency boilers can therefore be included as an energy saving measure.

Greece

Greece introduced an energy efficiency obligation scheme in January 2017 to complement their alternative measures. The Obligation Scheme ensures that obligated parties (energy distributors and retailers) will achieve a specific cumulative final energy saving target by 31 December 2020. The obligated parties are the suppliers of electricity, natural gas and petroleum products (excluding aviation fuels) that have an energy market share of more than 1 % of the total energy sold. The obligated parties can implement all types of measures (whether technical or behavioural) that can lead to final energy savings. The Regulator has developed and implemented a Control and Verification mechanism, which aims at the effective control and reliable verification of the actual implementation of the energy efficiency improvement measures implemented by the obligated parties. The Control and Verification Mechanism consists of a procedure of three stages. In the 1st stage, preliminary controls are carried out, in which the obligated parties have to submit separately for each energy efficiency improvement measure that has been implemented, specific documents and data to substantiate their implementation. In the 2nd stage, the Operator investigates a sample for more extensive control and verification procedures, whereas in the 3rd stage the Operator will perform thorough checks of the selected sample for each measure separately.

Examples of EEO Schemes in the Region

There is no EEO Scheme operating in Belarus but utility companies have to reach set energy efficiency indicators. All production industries also have an obligation to achieve set energy efficiency targets. These indicators and targets are set annually and checked by the DEE.

Other countries in the region that have developed NEEAPs (e.g. Ukraine, Moldova, Armenia, Georgia) have all opted for ‘alternative measures’ rather than an EEOS.

ANNEX E – CARBON TAX

A carbon taxation policy aims to improve the efficiency of energy use, encouraging the use of low emission fuels, creating incentives for companies to reduce their environmental impact and creating favourable conditions for the indigenous production of electricity.

Taxation of the energy's carbon footprint has an impact on the whole economy. The tax is an energy savings stimulus in each sector (households, transport, industry or tertiary) and assessment of the results of the measure entail monitoring of the carbon emissions prevented through the reinvestment of the Carbon Tax funds.

However, very little coal is used in Belarus and the use of gas for electricity generation will be reduced when the NPP is commissioned. This means that the potential savings from introducing a Carbon Tax are relatively small (around 75 kt. c. e. in the period 2021-2030) and the associated CO_2 savings are also small (126 kt). There is also a Presidential Decree related to not increasing taxation levels for citizens, so such a measure would be politically difficult to introduce. **For these reasons, a Carbon Tax scheme is not recommended for Belarus.**

ANNEX F – EMISSION FACTORS

Table F1 Emission factors

Measure	Final energy saving / primary energy saving / RES [kt c.e.]		Fuel/energy	Emission factor [kg CO_2eq/GJ]										CO_2 savings [kt CO_2eq]
				2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
State energy savings programme 2021-2025	final energy saving	4,000	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	4,909.6
	primary energy saving	875	all fuels, heat, electricity	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	1,307.1
	RES	125	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	57.9
State energy savings programme 2026-2031	final energy saving	3,300	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	1,527.5
	primary energy saving	525	all fuels, heat, electricity	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	1,078.3
	RES	125	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	211.3
Energy efficiency education and training	final energy saving	50	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	84.5
Metering and billing in buildings	final energy saving	702	heat and electricity	66.3	65.8	65.8	65.3	65.2	65.8	65.9	66.4	67.0	67.9	1,366.1
Insulation of buildings in residential sector (financed by international financial institutions, ESCOs)	final energy saving	2,787	all fuels, heat	37.9	36.4	36.1	34.7	34.6	34.3	34.0	33.7	33.5	33.2	2,789.6
The ESCO concept in public sector	final energy saving	179	all fuels, heat, electricity	61.1	60.4	60.4	59.8	59.6	60.1	60.1	60.5	61.0	61.7	317.8
The ESCO concept in social sector	final energy saving	109	all fuels, heat, electricity	61.1	60.4	60.4	59.8	59.6	60.1	60.1	60.5	61.0	61.7	193.5
The ESCO concept in industry sector	final energy saving	269	all fuels, heat, electricity	58.8	58.6	58.6	58.4	58.3	58.7	58.7	59.0	59.4	59.9	465.2
Modernisation of street lighting	final energy saving	162	electricity	114.6	117.0	117.8	120.0	120.4	122.6	123.3	125.2	127.3	130.0	590.1
Incineration power plant in Minsk	primary energy saving	398	heat, electricity	66.3	65.8	65.8	65.3	65.2	65.8	65.9	66.4	67.0	67.9	774.4
White certificates trade	final energy saving	46	all fuels, heat, electricity	57.3	57.0	57.0	56.6	56.5	56.8	56.8	57.1	57.4	57.9	77
Technology and Green Procurements	final energy saving	165	all fuels, heat, electricity	58.8	58.6	58.6	58.4	58.3	58.7	58.7	59.0	59.4	59.9	285.3
Eco-driving for Professional Drivers	final energy saving	57	gasoline, diesel	58.5	58.6	58.6	58.7	58.7	58.8	58.8	58.9	58.9	59.0	98.3
Sustainable urban mobility plans	final energy saving	811	gasoline, diesel	58.5	58.6	58.6	58.7	58.7	58.8	58.8	58.9	58.9	59.0	1,398.7
Exemplary role of the state	final energy saving	66	electricity	114.6	117.0	117.8	120.0	120.4	122.6	123.3	125.2	127.3	130.0	240.5
Energy management system (EnMS)	final energy saving	379	all fuels, heat, electricity	58.8	58.6	58.6	58.4	58.3	58.7	58.7	59.0	59.4	59.9	655.4
SECAPs	final energy saving	676	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	1,142.6
	primary energy saving	43	all fuels, heat, electricity	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	70.1	88.3
	RES	214	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	361.7

Measure	**Final energy saving / primary energy saving / RES [kt c.e.]**		**Fuel/energy**	**Emission factor [kg CO_2eq/GJ]**										**CO_2 savings [kt CO_2eq]**
				2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
Removing cross subsidies	final energy saving	398	heat and electricity	66.3	65.8	65.8	65.3	65.2	65.8	65.9	66.4	67	67.9	774.5
Financial incentives for RES		9,905	all fuels, heat, electricity	57.7	57.4	57.5	57.2	57.1	57.4	57.5	57.7	57.9	58.3	16,742.1
Carbon Tax	final energy saving	75	all fuels, heat, electricity	57.3	57	57	56.6	56.5	56.8	56.8	57.1	57.4	57.9	125.6