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ANALYTICAL REVIEW OF THE UPDATED NATIONALLY DETERMINED CONTRIBUTION OF UKRAINE TO THE PARIS AGREEMENT

July 2021

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CONTENT

1. PRECONDITIONS AND REQUIREMENTS FOR PREPARING THE UPDATED NATIONALLY DETERMINED CONTRIBUTION TO THE PARIS AGREEMENT

The response to climate change has in recent years become a top priority in many states' domestic and foreign policies, as humanity's efforts to reduce greenhouse gas (GHG) emissions over the next 10-15 years will determine the future for generations to come.

According to World Meteorological Organization reports, the average global temperature has risen by 1.2 ° C since the start of the industrial era (around the 1850s), and the last decade has been the hottest on record when compared to the results of previous instrumental meteorological observations.

Ukraine is no exception – we are also observing frequent abnormal meteorological phenomena – long-term heat waves, rivers drying out, an increase in the intensity and frequency of wildfires, anomalous precipitation, etc. Losses related to forest fires and floods alone reached more than UAH 25 billion in 2020.

These facts show there is an urgent need to tackle the climate change problem. Among its causes are extraction-generated emissions; the transportation and incineration of coal, oil and gas; GHG emissions by industry and agriculture; the low energy efficiency of buildings; the lack of a waste management system; and reduced carbon sequestration by ecosystems, primarily forests, etc.

To unite all states in a global response to climate change, the Paris Agreement under the United Nations Framework Convention on Climate Change (from now on referred to as UNFCCC) was signed in 2015, succeeding the Kyoto Protocol in 2021. Ukraine was one of the first European countries to ratify the Paris Agreement.

Key differences between the Paris Agreement and the Kyoto Protocol:

- Changing the essence of the emission reduction target from "commitment" to "contribution". The Kyoto Protocol envisaged a legally binding amount of greenhouse gas emissions for each state (a fixed threshold not to be exceeded). Simultaneously, the Paris Agreement gives each country the right to determine its contribution to GHG emissions reduction, based on its own national context.
- The inclusion of all states with approved plans to reduce GHG emissions in the regime of nationally determined contributions. The Kyoto Protocol envisaged quantitative commitments to reduce GHG emissions only for developed countries (Annex B to the Kyoto Protocol). In contrast, the Paris Agreement consolidates the contributions from the countries that are Parties to the Paris Agreement.
- The introduction of a bottom-up approach instead of a top-down one, enabling all participants (not only at the national but also at the local or even corporate level) to contribute to GHG emission reduction.

The Paris Agreement sets the shared goal of keeping the global average temperature well below 2°C above pre-industrial levels, and limit the overall temperature rise to 1.5°C, recognizing that this would significantly reduce climate change risks and consequences.

However, current national GHG emission reduction targets could cause the average global temperature to increase by 2.9°C to 3.4°C on pre-industrial levels (World Meteorological Organization, 2020) by the end of the 21st century. This shows that humanity is far from achieving the goal of preventing a global temperature increase of 1.5°C to 2°C compared to pre-industrial levels, so the climate change response is more deeply integrated into international political and trade processes.

According to the provisions of the Paris Agreement, all Parties must update their NDCs every five years.

In July 2020, Ukraine officially supported the European Green Deal or EGD, which is designed to make the European continent climate-neutral by 2050.

Ukraine will always be integral to achieving the EGD's goals, and has stated that the EGD concept is, among other things, a logical extension of international efforts to green country's economy.

In March 2021, the Cabinet of Ministers of Ukraine approved the National Economic Strategy until 2030, through which climate neutrality is to be achieved no later than by 2060.

As an active participant in the future global climate change response and adaptation, recognizing its responsibility to achieve the goals set in the Paris Agreement, and guided by national interests and priorities, the Government of Ukraine offers a vision of sectoral transformations, policies and measures to facilitate the transition to a climate-neutral economy in the second half of this century. This is to be done using the most economically and socially optimal means, based on fairness, and in the context of sustainable development and efforts to eradicate poverty, as required by Article 4 of the Paris Agreement.

1.1 OUTCOMES OF STATE POLICIES IN 2015-2020 CONTRIBUTING TO DECARBONISATION AND GHG REDUCTION

Over the past few years, Ukraine has taken many steps to significantly reduce energy consumption, and to develop energy efficiency and renewable energy, these currently being the key measures implemented to reduce GHG emissions.

The Renewable Energy Source (RES) share in electricity production has increased from 7.9% to 11.3% (2015-2020, including production by Hydroelectric Power Plants (HPPs). RES capacity (excluding large HPPs and PSPPs) in Ukraine increased from 0.8 GW (2015) to 8.5 GW (February 2021), with EUR 6.2 billion invested.

More than EUR 500 million has been invested in 2.4 GW of heat-generating capacity using alternative fuels through the introduction of an incentive tariff for heat produced by RES, set at the level of 90% of the current gas-generated heat tariff.

According to the State Statistics Service of Ukraine, the country's GDP energy intensity has decreased by 32.3% over the last reporting decade (2010-2019) – from 0.368 to 0.249 tons of oil equivalent per thousand GDP international dollars[1]. At the same time, the lowered energy intensity is clearly connected to the higher share of electrical energy in final consumption (from 15.6% to 20.3% during this period).

Within this package of critical reforms, we should also note support for public energy efficiency awareness: the State Target Economic Programme for Energy Efficiency and Development of Energy Carrier Production from Renewable Energy Sources and Alternative Fuels for 2010-2021 (the Warm Loans Programme), local co-financing programmes for energy efficiency measures, and the Energy Efficiency Fund.

The Warm Loans Programme enjoys steadily high demand among people. In particular, 853 thousand of Ukrainian families raised around UAH 8.15 billion for energy efficiency of their housing. As a result, the households saved more than 480 million m3 of gas, or 932 thousand tons of CO2 annually.

The Energy Efficiency Fund has managed to accumulate more resources for energy efficiency measures, which helped save up to 50% on payments.:

1 2019 – not including the temporarily occupied territories of Luhansk and Donetsk regions and the Autonomous Republic of Crimea and the city of Sevastopol.

Since 2016, the energy service mechanism has been realized in Ukraine to implement energy efficiency measures at communal and state-owned facilities (budget-funded institutions such as schools and kindergartens. More than 550 ESCO agreements, together worth UAH 1.25 billion, have been concluded between 2016 and 2020. In 2020, the coverage of energy service in Ukraine was for the first time extended to include budget-funded institutions, such as schools, hospitals etc.

The prevalence rates of electric vehicles are growing in Ukraine, and the charging infrastructure network is actively evolving to ensure maximum convenience for electric vehicle users.

At the community level, Ukraine is actively implementing a voluntary European Union initiative – the Covenant of Mayors for Climate and Energy. As of 1 March 2021, there were already 257 signatories of the Covenant of Mayors in Ukraine, covering 20.1 million citizens (184 communities set targets to reduce GHG emissions). As part of their commitment, communities develop a Sustainable Energy and Climate Action Plan (SECAP) containing specific GHG emission reduction targets, along with measures and projects to prevent and adapt to climate change, and to overcome energy poverty.

1.2 GHG EMISSION TRENDS IN UKRAINE

According to the National Cadastre of Anthropogenic Emissions from Sources and GHG Sequestration in 2018, GHG emissions in Ukraine totalled 341.9 million tons of CO_{2eq} (including the LULUCF (land use, land use change and forestry) sector) or 339.2 million tons of CO_{2eq} (excluding the LULUCF sector). Comparing to 1990, total GHG emissions and sequestration level in 2018 decreased by 61.3%, but compared to 2017 they increased by 8.6% or by 29.4 thousand tons of CO_2 equivalent. According to the National Cadastre of Anthropogenic Emissions from Sources and GHG Sequestration in Ukraine for 1990-2019, GHG emissions in Ukraine totalled 332.2 million tons of CO_{2eq} (including the LULUCF sector), which is 62.4% less than the 1990 level.

Total and sectoral GHG emissions and sequestration levels from 1990 to 2018 are presented in Fig. 1.1 and Fig. 1.2.

Fig. 1.1 Overall GHG emissions compared to Ukrainian GDP growth, 1990-2018

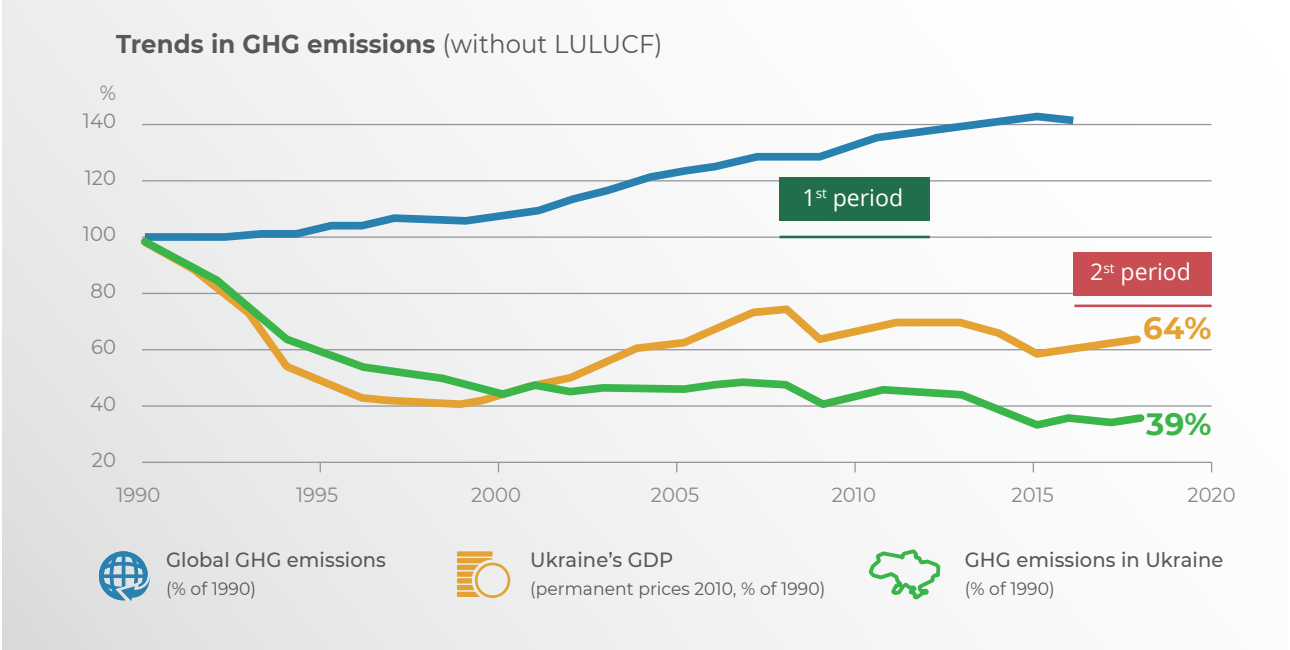
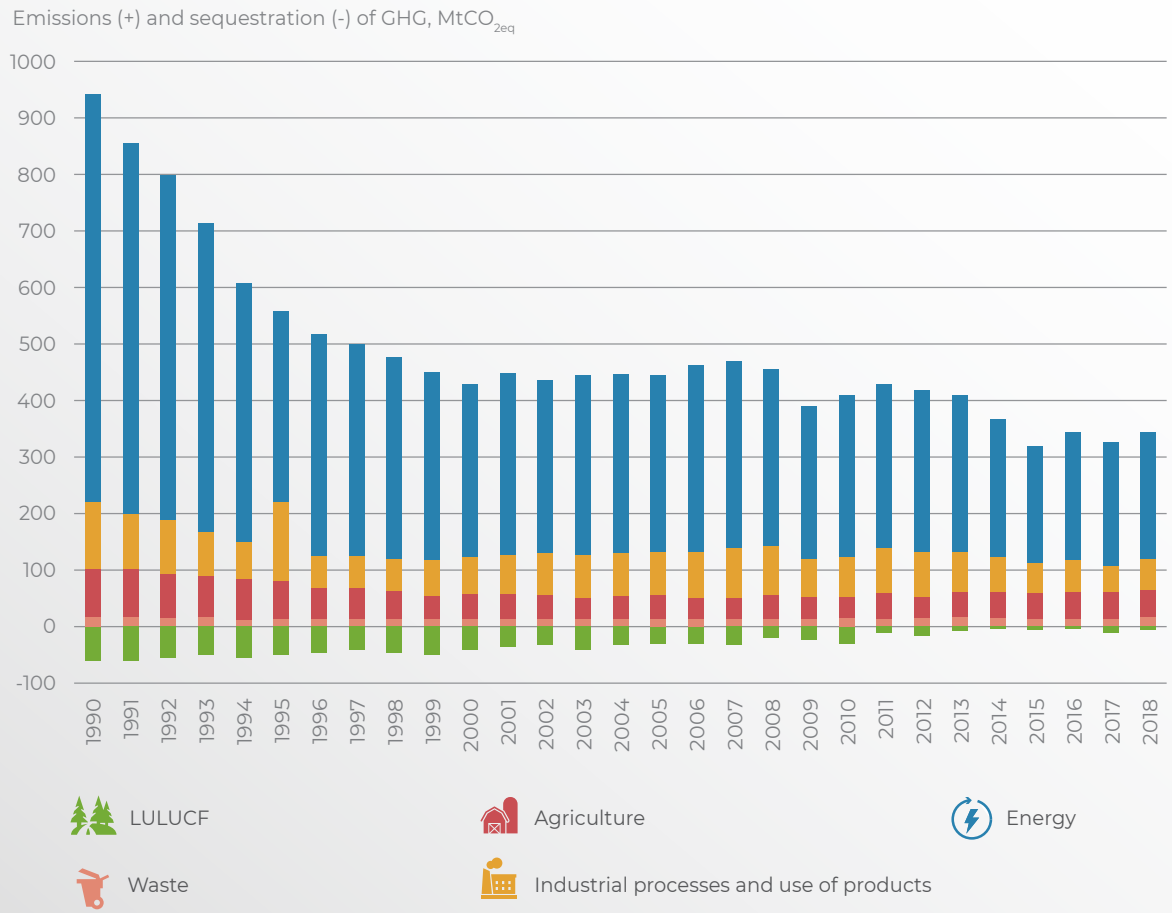


Fig. 1.2 Overall GHG emissions in Ukraine – sectoral trends, 1990-2018



In 1990-2018 the overall GHG emissions trend was characterized by the following key stages:

- A sharp GHG emissions reduction from 1990 to the early 2000s, caused by the collapse of production (industry and agriculture) due to the breakup of the Soviet Union and, as a result, lowered fuel consumption by the economy. This period is also characterized by structural changes to the economy and the dynamic development of the services sector, as well as by a sharp GDP decrease, with the Ukrainian population becoming poorer. The stabilization of GHG emissions from the early 2000s to 2008, and a doubling of GDP, characterized by the growing production of mineral and metallurgical products, as well as general economic growth. During this period, the energy sector's consumption of solid fossil fuels also went up without significantly increasing overall greenhouse gas emissions, due to modernization and energy efficiency measures being carried out by industry.
- The GHG emissions reduction of 15% in 2009 compared to 2008, due to the impact of the global economic crisis, in particular, the production of cement, ammonia and metal products decreased significantly. A 13% GDP decline occurred in Ukraine, and GDP has still not rebounded to its 2008 level. The slight increase of GHG emissions level in 2010-2013 as a result of the general recovery of the economy, which was hit by the global crisis of 2008.
- A sharp GHG emissions reduction in 2014-2015, caused by the economic downturn due to the annexation of the Autonomous Republic of Crimea and the city of Sevastopol by the Russian Federation, as well as the commencement of hostilities in Donetsk and Luhansk regions, where the majority of heavy industry facilities were concentrated, along with natural resources extraction and consumption sites; in addition, Ukraine's GDP dropped sharply and its population

became dramatically poorer. Due to considerable hryvnia devaluation and the need to rise energy resource prices greatly, the population became yet more poorer. The GHG emissions fluctuations in 2016-2018 at the level of 320-340 million tons of CO2 equivalent. This period is characterized by the start of the active implementation of energy efficiency policies (the Warm Loans programme, launched to promote energy efficiency measures for buildings, the replacement of gas boilers with biomass boilers, etc.) and a gradual reduction in tariffs (natural gas, hot water and heat) to market values), which made several energy efficiency measures more attractive from an economic point of view.

Considering the abovementioned, a decoupling between GDP dynamics and GHG emissions can be observed – GDP growth has not been followed by a proportional increase in GHG emissions since 1999. However, the level of GHG emissions is still directly dependent on the production, supply and consumption of energy resources.

Ukraine's per capita GDP (2020, based on the SSS data) was USD 3,726.94. Its total GDP was USD 155.6 billion in 2020.

1.3 MODELLING GHG EMISSIONS AND OVERALL INVESTMENT SCENARIOS AND FORECASTS

The Second Nationally Defined Contribution of Ukraine (from now on NDC) has been prepared using economic and mathematical modelling (with development scenarios for all sectors of the Ukrainian economy until 2050). A special TIMES-Ukraine model was used by the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, a specialized mass balance model for the "Waste" sector, Excel tables for the "Agriculture" and "Land Use, Land Use Changes and Forestry" sectors. A dynamic model of the overall balance of the Ukrainian economy (MOB-Ukraine) was applied to assess the social-economic consequences for each scenario.

The combination of an energy system optimization model, macroeconomic (MOB) and sectoral models is the most widespread approach used to identify long-term, financially balanced methods of economy and energy sector development and GHG emissions monitoring.

The TIMES-Ukraine model is an optimization model of Ukrainian energy flows (a bottom-up model), and a basic model of the tools use to evaluate energy and fuel consumption by sector and energy technology type, GHG emissions levels, and costs (including investments). The domestic energy system is represented in the TIMES-Ukraine model by a single region, and consists of seven sectors: the energy supply sector (production, import, export, etc.); primary energy conversion and transformation sector (electricity and heat production, oil processing, etc.); industry; transport; the household sector (population); trade and services; and agriculture (including fishing). The model structure corresponds to the structure of the state energy balance. The model's database is calibrated using 2012 data. The core data were updated for 2013-2018. The TIMES-Ukraine model is fully harmonized with the guidelines of international organizations responsible for developing energy and environmental forecasts, particularly the recommendations of the UNFCCC Secretariat regarding national notification.

The model contains a detailed database of inputs on the current situation in all sectors of the Ukrainian economy, and over 1,600 technologies and measures to model the most optimal ways to decarbonise the economy.

The waste sector modelling toolkit was designed using mass balance calculation methodology, and applied in the course of drafting the National Waste Management Strategy 2030.

A combined approach was used to model GHG emissions in the agriculture and forestry sectors, taking into account both IPCC recommendations and the national "bottom-up" approach. Fuel consumption in the waste and forestry sectors was taken into account in energy sector modelling with TIMES-Ukraine.

This modelling approach was applied to:

- assess the economic and environmental consequences of the implementation of previously adopted sectoral strategies and action plans in Ukraine;
- identify the sectors with the most significant potential for GHG emissions reductions;
- calculate the most optimal, economically and environmentally balanced vectors of economic development;
- identify measures that are financially feasible and should be implemented first in the economy (as those with acceptable payback period and additional positive effects);
- assess economic development vectors based on the criterion of summary expense minimization.

Sources of inputs and data for modelling are presented in detail in a set of reports published on the website of the Ministry of Environmental Protection and Natural Resources of Ukraine[2].

COVID-19 context. The core modelling process was completed in 2020. Therefore, scenarios do not consider the current economic situation related to the COVID-19 pandemic and the economic downturn in 2020. According to preliminary evaluations, due to the decline observed in industrial production and energy consumption areas, GHG emissions in Ukraine will have fallen in 2020. Still, they are expected to grow again during the economic post-pandemic recovery.

GHG emissions generated by the temporarily occupied territories (NGCAs). Currently, the NDC project includes emissions from NGCAs, but there is no reliable information regarding the number of operating enterprises, institutions and organizations, their production capacity, the amount of energy produced and consumed, etc. The complicated process of data collection and reporting required for the annual National Cadastre of Anthropogenic Emissions from Sources and GHG Sequestration in Ukraine does not allow for a complete estimate and forecast of future GHG emissions to be made. Thus, GHG emissions generated within the NGCAs are calculated according to an expert-based approach, and estimates. It is assumed that after the restoration of state territorial integrity (with the use of reliable sources of information) estimates of GHG emissions in all sectors of NDC will be revised.

Energy sector transformation needs: The abovementioned modelling toolkit used to prepare NDC calculates only investment and operational costs to support the predetermined economic development indicators and, respectively, energy volumes. All calculations for programmes for coal region transformation are to be presented separately.

Taking GDP growth into account. According to the projected macroeconomic scenario designed for the purposes of Ukraine's NDC, average GDP growth of 3.5-4.5% is expected for 2018-2050 as a result of structural macroeconomic reforms in Ukraine.

2 https://mepr.gov.ua/news/33080.html

2. THE OVERALL TARGET FOR GHG EMISSIONS REDUCTION

The Updated Nationally Determined Contribution of Ukraine to the Paris Agreement stipulates that **by 2030, GHG emissions should not exceed 35% of their level in 1990,**

35%

or that by 2030, GHG emissions should fall by **65% of their level in 1990.**

65%

Ukraine has set the goal of becoming **climate-neutral not later than 2060**

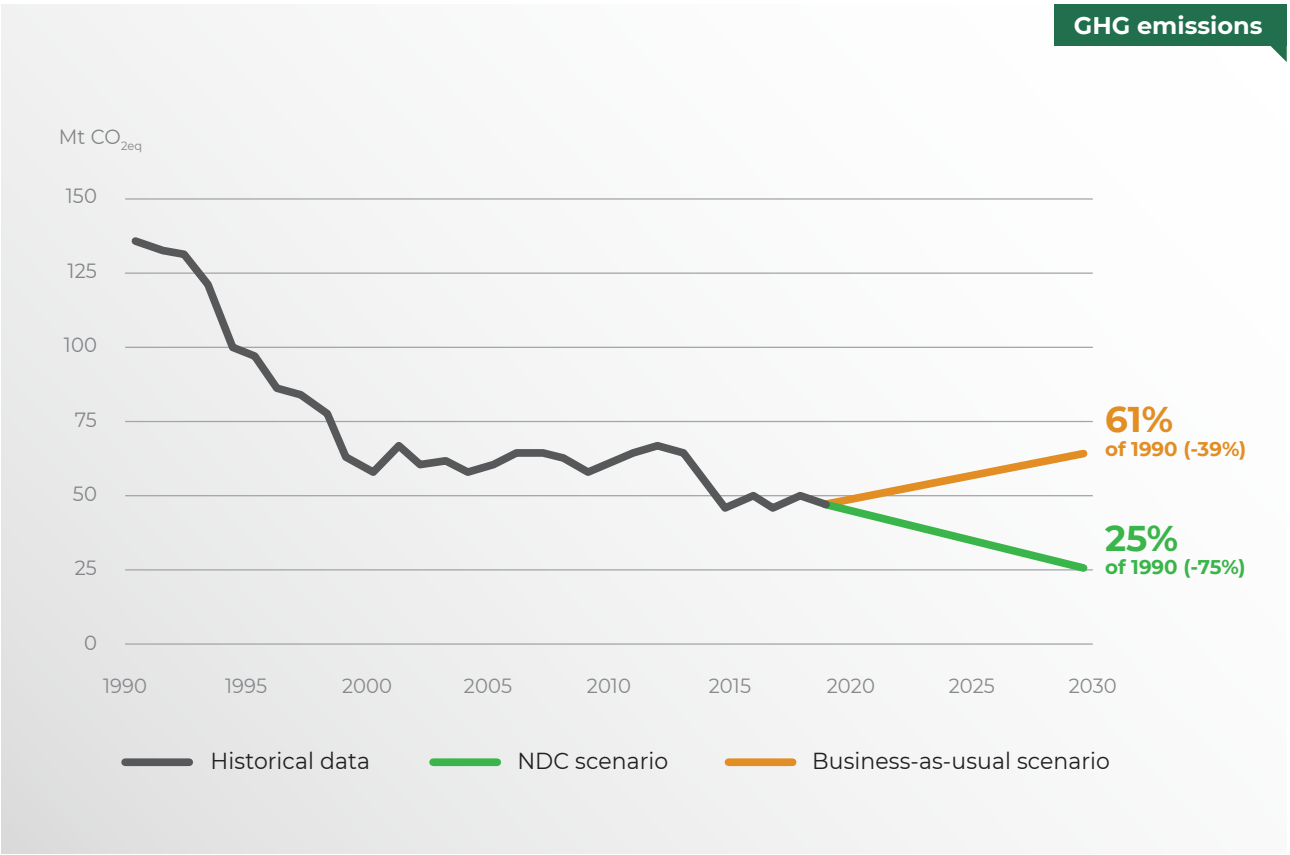
2060

2.1 ENERGY SECTOR

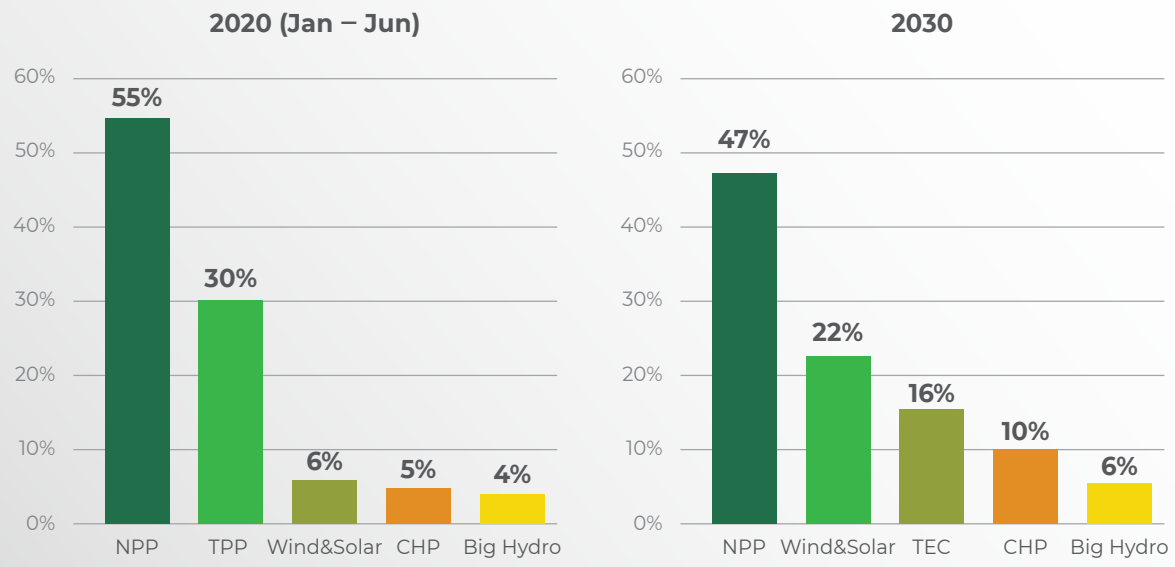
2.1.1 ENERGY AND HEAT PRODUCTION

In 2018, the electricity and heat sector (centralized generation of heat and electricity by power plants) reached around 21 million tons of oil equivalent (244 TW/h) with an overall GHG emissions volume of approximately 99 million tons CO_{2eq} (36% of 1990 emissions level).

By 2030, the electricity and heat sector's emissions must drop by approximately 26% of the 2019 level, reaching 68.1 million tons CO_{2eq}.



Electricity production structure



ELECTRICITY SECTOR

Considering expected economic growth and the rise of the share of electricity in energy consumption, demand for electrical energy in Ukraine is projected to increase by about 30% over the next decade. It will thus exceed 150 TW/h by 2030. To meet this demand, gross electricity generation must increase up to 190 TW/h, taking into account transmission losses and the power generation sector's own electricity consumption.

Ukraine will also have to modernize or replace most of its existing coal power plants to meet the pollution limits set in Directive 2010/75/EC on industrial emissions (integrated pollution prevention and control), in the scope and terms provided for by Annex XXX to the Association Agreement and the Protocol concerning the Accession of Ukraine to the Treaty Establishing the Energy Community. Renewable energy sources could be an economically effective substitute for obsolete coal power stations. Ukraine's aspiration to integrate into the European ENTSO-E system will change the economic and technological requirements for the electrical energy system, and correspondingly new facilities will be needed. This will provide a strong impetus for deep structural change in the Ukrainian energy system to guarantee a secure, cost-effective and low-carbon electrical energy supply. According to modelling results, in 2030 the electricity generation sector will be dominated by nuclear generation (90 TW/h with ICUF at 75%), renewable sources (including large HPPs and PSPPs) with guaranteed 60 TW/h, and existing coal power plants – 25 TW/h, with a minor share left to current and future gas generation and motor vehicle producers.

The substitution of fossil fuels with renewables alone will result in an overall reduction in GHG emissions by 2030, to 41% of 1990's level.

To achieve this goal, the production of electricity from renewable sources must increasebetween 2020 and 2030. According to the Energy Strategy of Ukraine 2035, the share of RES (including hydro generation and thermal energy) in TPES will be 17% in 2030, and 25% in 2035. To ensure that about 80% of electricity produced in 2030 is carbonless, the share of RES in overall electricity generation should grow from 17% to 30%, according to modelling results, combined with current nuclear generation.

Modelling does not indicate a need to introduce additional nuclear generation capacity by 2030, as the existing number of core capacities is sufficient. And after 2030, the completion of construction of reactors 3 and 4 at Khmelnytskyi NPP will also not be economically justified, given the high market prices for constructing reactors (about $7,000 per kW of installed capacity).

HEAT SECTOR

Two opposing factors characterize heat sector development: on the one hand – increased demand stimulated by economic growth, and on the other – reduced demand due to energy efficiency improvements. Heat demand is projected to increase by 30% compared to 2018 due to the slow pace of the modernization of buildings, increased energy efficiency in the industrial sector, and sustainable economic growth. Nonetheless, due to the modernization of heat-producing facilities and an increased share of biomass-generated heat, GHG emissions from the heat sector are projected to decrease.

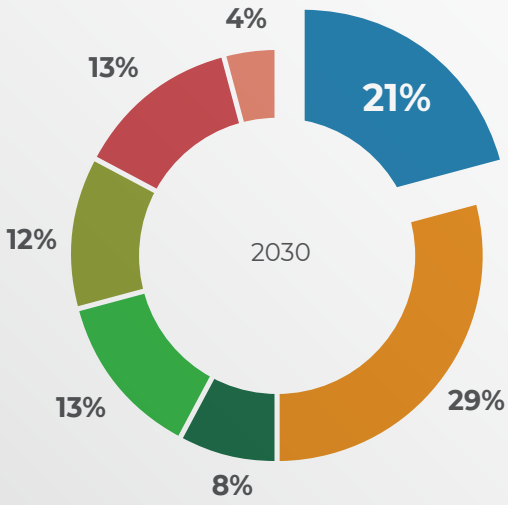
Currently approximately 90% of fuel inputs at TPPs and about 80% at CHPPs are fossil fuels (coal and gas). To decarbonize, Ukraine must increase the share of biomass and bioenergy capacity in the agricultural and waste sectors. Improvements in this area will accelerate due to the implementation of two EU Directives regulating decreases in pollutant emission levels: Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) and Directive 2015/2193/EU on the limitation of emissions of certain pollutants into the air from medium combustion plants. Over the long-term, this will reduce the competitiveness of coal power generators (heat and electricity) compared to RES.

To achieve the GGH emissions target in this sector, the share of RES at TPPs will have to increase from 14% to 18% by 2030, with a 30% absolute rise in biomass-generated heat (to 6 TW/h by 2030).

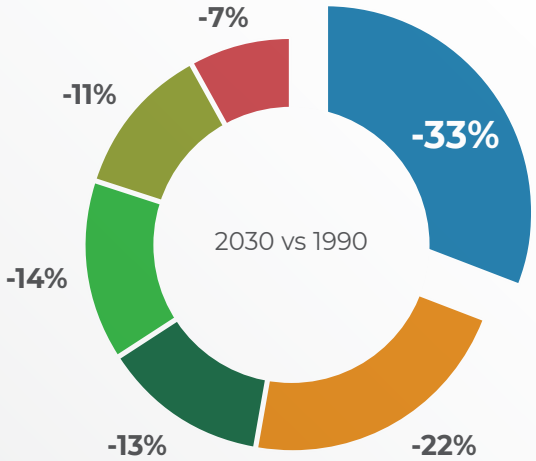
NDC also stipulates the modernization of heat supply objects, and so TPP-generated emissions will decrease from 16 million tons of CO_{2eq} in 2018 to 13 million tons of CO_{2eq} in 2030.

Emissions

GHG emission structure



GHG emission reduction percentage



Energy
Buildings
Transport
Waste
Industry
Energy supply
Agriculture

2.1.2 WHAT ARE THE BENEFITS FOR UKRAINE?

The substitution of obsolete power stations and CHPPs with more efficient power plants using RESs will improve the overall situation in the domestic energy sector in several areas simultaneously:

- Due to their age, Ukrainian TPPs have become more vulnerable to accidents and unexpected shutdowns. Their replacement would contribute to the security of the energy system.
- In the context of Ukraine's international commitments, the replacement of obsolete TPPs will substantially lower Ukraine's GHG emission levels.
- Reducing the use of fossil fuels in generation capacity would further positively affect public health. TPPs are among the country's leading sources of toxic pollutants such as NOx, SOx, and PM2.5, which cause a range of cardiovascular and other diseases among Ukraine's population.

Additionally, the international financial system is keen to limit its investment flows mainly to the construction of renewable energy objects. Investors are retreating from high-carbon investments, and the redistribution of investment flows to low-carbon technologies increases the cost of capital to construct high-carbon objects. Investments in renewable energy in Ukraine are thus recognized as being cost-efficient compared to investments required to modernize fossil fuel-based electricity generating capacities.

Finally, Ukraine wishes to integrate its electricity grid with ENTSO-E. The enhanced energy security and lowered GHG emission levels envisioned in the NDC are key steps for connecting the national grid to the continental European electricity system.

2.1.3 WHAT IS THE COST OF NDC FOR UKRAINE?

The main share of investment in 2021 – 2030 must go to constructing 15 GW of new wind, solar and biogas capacities, and to increase the percentage of biomass used at heating plants and CHPs.

NDC projects overall investment of EUR 26 billion in the heat and electricity sector, including EUR 20 billion in renewable energy sources by 2030. Some 80% of it (EUR 16 billion) will be spent on building new electricity generation facilities, and 20% (EUR 4 billion) on biomass use in CHPs and heat plants. An additional EUR 5 billion will be required for investment in constructing new gas power plants and retrofitting old TPPs. Considering that the goal in the above-mentioned sector was adjusted with the RES share ambition reduced, the amount of investments required will also decrease, however this needs detailed additional model calculations.

The average annual investment in the "Electricity, gas, steam and air-conditioning supply" sector from 2010 to 2018 was EUR 1.4 billion, indicating that investment flows will have to double over the next decade.

Today's average system-wide electricity generation costs are approximately 30 EUR/MW/h. The installation of 15 GW of new RES capacity will increase the average system-wide electricity generation costs to approximately 50 EUR/ MW/h. The scenario in which there is no RES capacity development predicts system costs at the level of 35 EUR/MW/h. However, such lower costs could be achieved only in the absence of the TPP capacity modernization foreseen under the National Plan for Cutting GHG Emissions from Large Combustion Plants, which urgently needs to be implemented in the near future.

According to the international practice of green funding, financial institutions (institutional investors) or private sources (corporations, households and project developers) are the key investment sources for RES electricity-generating capacity.

In line with global trends, private investment must be a key source of funds for developing the energy (electricity and heat) sector.

In Ukraine, a combination of loans and private capital should be the core financial tool for the installation of an RES object. Moreover, the green tariff (presumably revised) should stimulate further investment in small RES capacities (e.g., households).

To guarantee an increasing flow of private investment into the development of renewable electricity generation capacity, Ukraine must ensure:

- the further improvement of electricity market operations,
- the abolishing of production price subsidies, while retaining targeted subsidies for energy supplies to vulnerable groups,
- the introduction of market-based rates (for electricity and heat),
- the implementation of predictable, competitive auctions for RES construction projects,
- the creation of a reliable funding environment for investors in Ukraine.

2.1.4 SECTORAL CHALLENGES

The key challenge for the energy sector is to ensure the required investments are made. Policies and measures aim to improve investors' expectations about the quantity of electricity they will be able to sell in the future so as to secure their investments and ensure overall economic growth in Ukraine. In addition, the current market's concentration in the hands of only a few companies is another substantial obstacle for new investors and companies.

To substitute fossil fuel-powered plants with renewable-based ones, Ukraine should:

- develop a decommissioning mechanism for thermal power and heat plants,
- develop a modernization plan for TPPs to fulfil the EU's requirements for large combustion objects,
- draw up a fair closure schedule for coal mines and formulate an efficient regional structural policy,
- formulate long-term renewable capacity auctioning targets,
- strengthen the market liberalization process in the electricity sector,
- increase the overall level of economic stability in Ukraine,
- implement a consistent energy and climate policy to enhance investors' confidence in the future profitability of their projects.

In the heat supply sector, subsidized and low heat prices have in the past been a huge obstacle to the required investment flows. However, abolishing subsidies will not be sufficient to attract new investments into the heat sector, as there are also problems due to the demand for centralized heat distribution. The decarbonisation of the heat sector will only be productive if the abovementioned measures are combined with substantial efforts to reduce heat consumption by residential buildings and by industry.

2.1.5 POLICIES AND MEASURES

Ukraine has presented several strategies, plans and concepts for electricity and heat sector development, including:

- The strategy for Low-Carbon Development 2050
- The Energy Strategy of Ukraine 2035;
- The Action Plan to implement the Reform of the Energy Sector (2020) stage of the Energy Strategy of Ukraine 2035;
- The National Action Plan on Energy Efficiency 2020, and draft of this plan up to 2030;
- The Concept of State Policy on Heat Supply 2035.

Additionally, several ministries are involved in the design of other policies:

- introducing market-based electricity prices for consumers;
- introducing RAB-tariffs for operators of electricity transmission and distribution systems;
- developing individual RES-based heat supply systems;
- developing hydrogen energy;
- introducing energy audits and energy management at industrial enterprises
- implementing a system for monitoring, reporting and verifying GHG emissions in the industry and energy sectors;
- introducing a system of emissions trading (starting in 2025-2027);
- adopting a plan to close non-profitable state coal mines.

As mentioned above, Ukraine has sufficient biomass potential. It may help to introduce requirements for the incorporation of biogas in-state gas networks, and biodiesel in the fuel mix used by vehicles.

Along with increasing the share of RES in electricity generation, the implementation of policies and measures should also boost the efficiency of heat generation. Losses could be reduced by 8% in heat production, and in heat distribution by 12%. The introduction of a free market for heat supplies would funnel investments towards energy efficiency improvements.

All supply-backed measures should be complemented with demand-backed ones to ensure the efficient use of heat in buildings and industry.

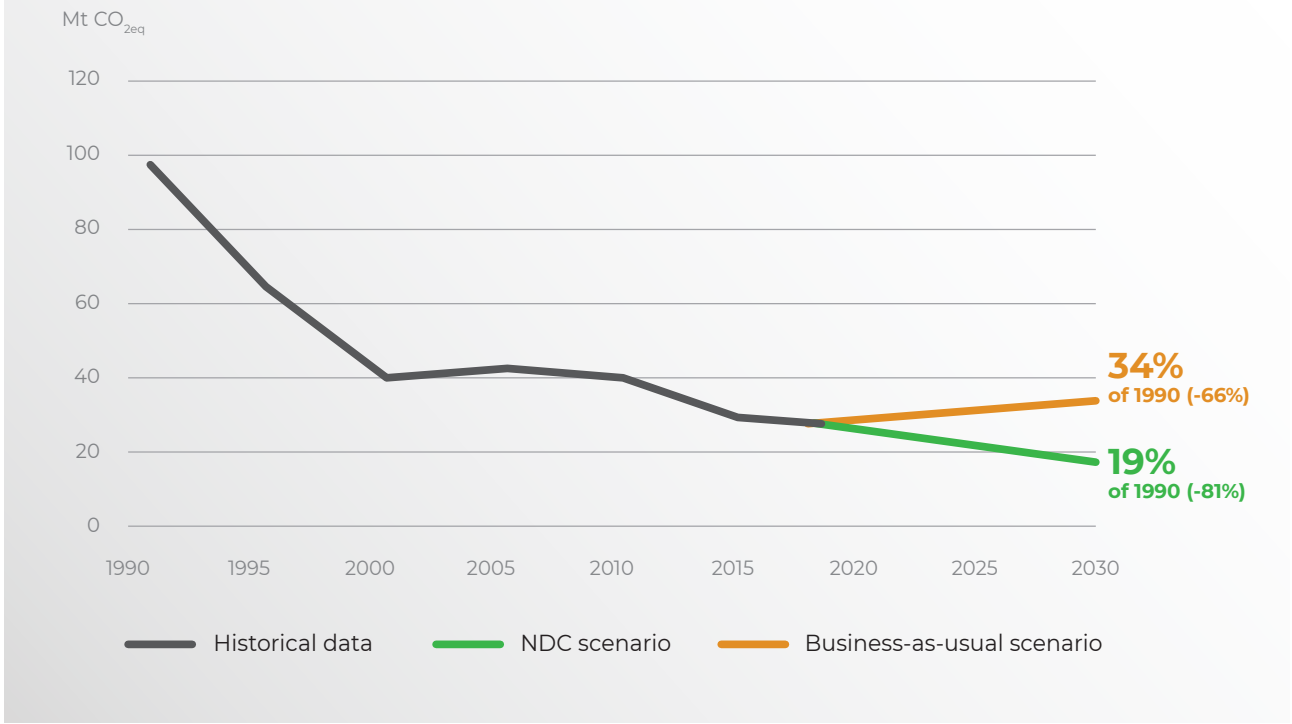
2.2 BUILDING SECTOR

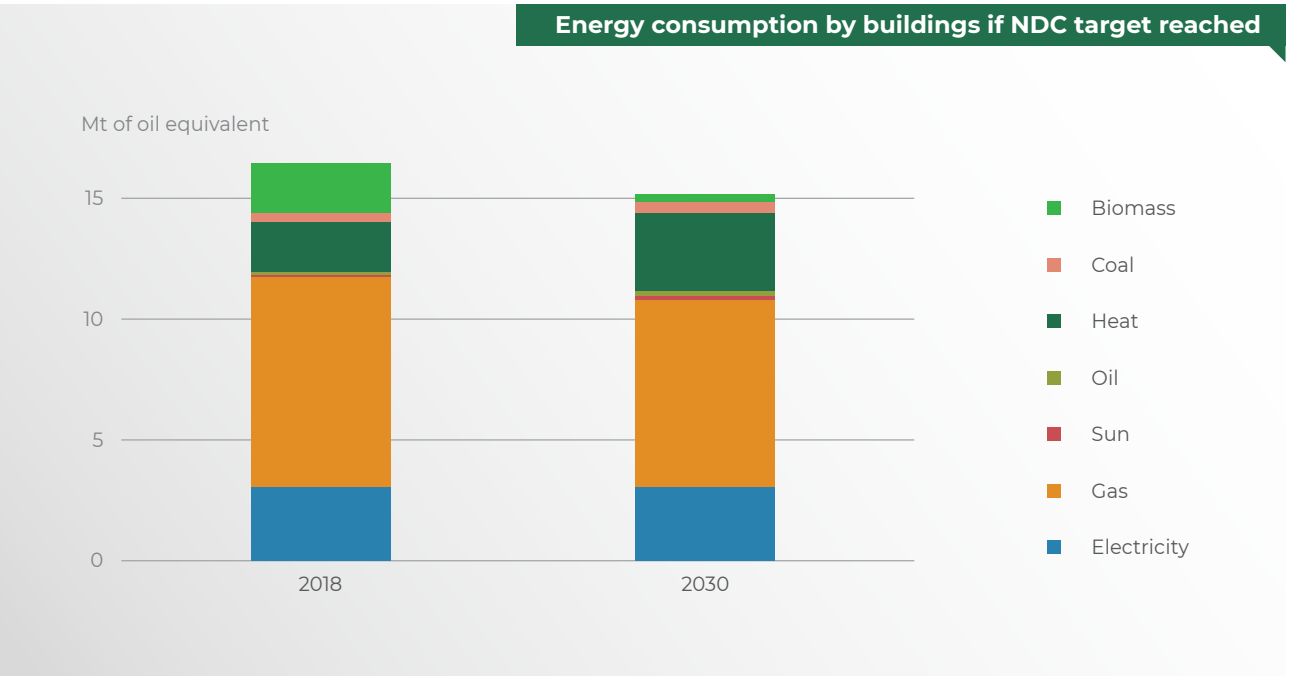
COMMERCIAL, PUBLIC, RESIDENTIAL NOT CONNECTED TO CENTRALIZED HEAT SUPPLY

In 2018 the sector of buildings not connected to centralized heat supply emitted 28 million tons of GHG (in CO_2 equivalent, $MtCO_{2eq}$) with 89% coming from residential buildings and 9% from commercial buildings, respectively, whereas the rest 2% was provided by fixed fuel combustion in industrial production in agriculture, forestry, and fishery.

NDC aims to lower emissions in the entire building sector to 19.8 $MtCO_{2eq}$ by 2030, which corresponds to a 10% decrease compared to the 2019 emission level. GHG emissions in this sector are mainly created by buildings not connected to centralized heat supply (CHS), however there is also a rather large share of buildings connected to CHS but using a carbon-intensive gas for cooking and water heating. Besides, a considerable share of buildings need thermal modernization but GHG emission reduction due to implementation of such measures in buildings with CHS or electrical heating will occur indirectly in the electricity and heat production sector.

GHG emissions in buildings





To reach this goal of GHG emission reduction in buildings, approximately EUR 1.3 billion in overall expenditure is required annually (including for thermal modernization measures both in buildings with CHS and those without it). Another EUR 340 million annually is needed to replace and modernize existing boilers and heating systems within buildings. Total costs would therefore reach EUR 16 billion.

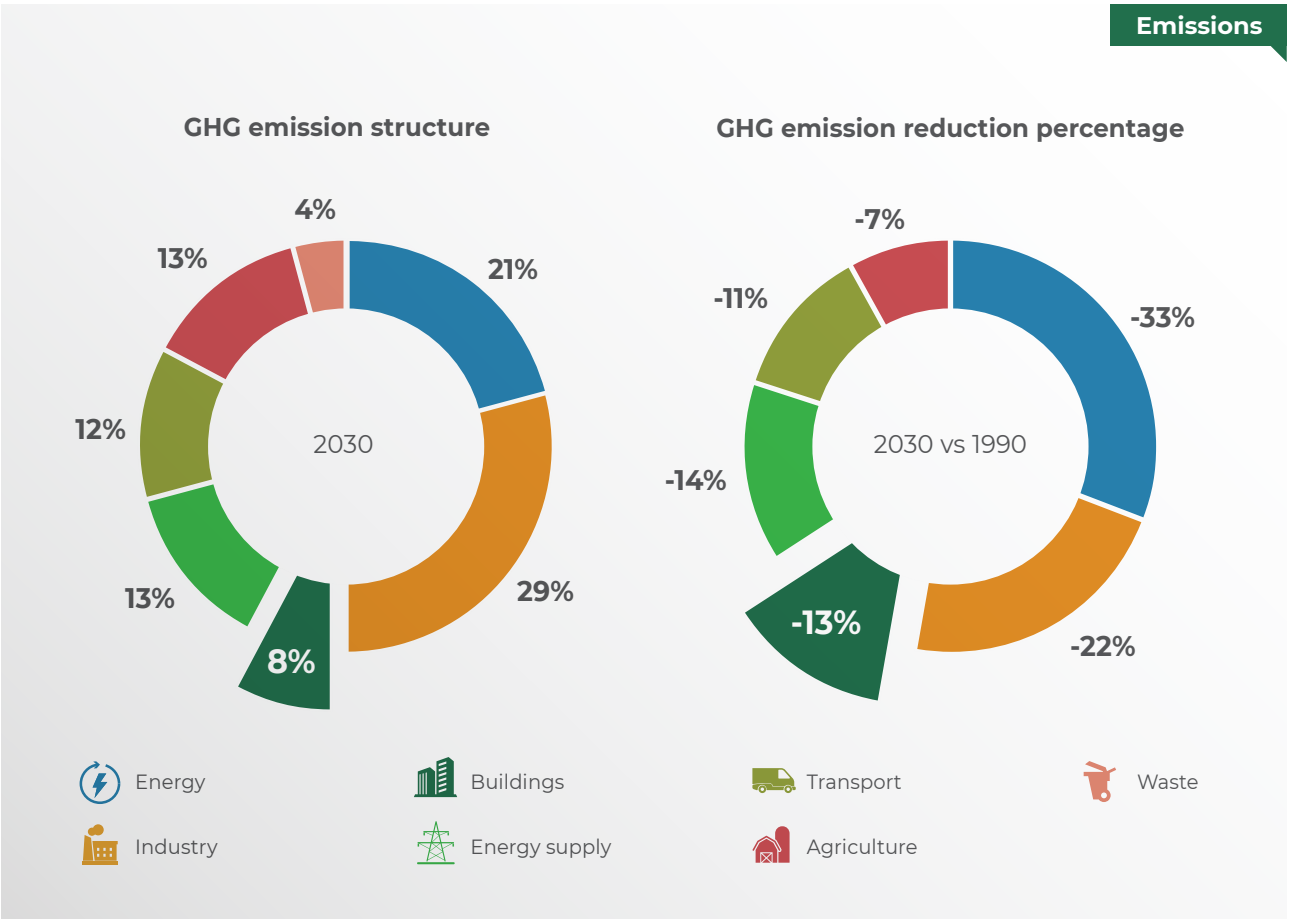
2.2.1 WHAT ARE THE KEY TRANSFORMATIONS?

Ukraine's current building sector comprises a sizeable residential segment with the total housing stock area, including CHS-connected buildings, of approximately 1 billion m², and a public/commercial segment of roughly 300 million m² in area. However, residential buildings consume far more heating energy per m² than commercial and public ones, and are responsible for more significant emissions.

GHG emissions from residential buildings not connected to centralized heat supply amounted to 19.9 million t of CO_{2eq} in 2019 whereas public and commercial buildings only generated 2.2 million t of CO_{2eq}. Importantly, greenhouse gas emissions created by the buildings connected to centralized heat supply are accounted for in the energy sector as those from fuel combustion for thermal energy production.

To cut emissions and expenses, at least four key measures must be taken: (1) launch a nationwide modernization of buildings, (2) replace low-efficiency boilers with modern equipment, (3) substitute fossil fuels with renewables in individual heating systems, and (4) initiate nationwide residential building construction (new buildings with minimized energy consumption needs).

The NDC goals set for the building sector are achievable (a 10% cut in GHG emissions in 2030 compared to 2019 for the buildings directly creating GHG emissions) if the annual level of residential buildings modernization is 1.3%. This means that every year 1.3% (over 13 million m²) of existing residential building space has to be modernized. Given the additional financial investment, the share of building thermal modernization can grow to 3% in order to increase the thermal modernization rates, which is one of priority areas in Ukraine in terms of possible GHG reduction. It should be noted that GHG emission reduction directly in the buildings connected to CHS will not happen if thermal modernization of buildings results only in decreased centralized supply of heat or electricity, however



thermal modernization measures are of extreme importance both to reduction of consumers' financial expenses and improvement of their comfort and to decrease of emissions at the national level due to decline of production, first of all of thermal energy at its generation facilities using carbon-intensive energy resources.

Simultaneously, NDC envisages also the replacement of the fuels used for heat production in residential buildings. Between 2020 and 2030, the share of individual heat supply must decline (primarily due to a reduced share in natural gas and biomass) with the share of centralized (especially biomass-generated) heat supplies growing substantially. Meanwhile, providing biomass-based centralized heating needs construction of new thermal power plants operating on that fuel, which requires a well-thought decision and subsequent promotion of such development. People should also be encouraged to use more solar energy for hot water and heat supplies (if applicable).

In the long-term perspective, the building sector must ensure the construction of new objects with "zero-energy" consumption (ones that produce the same amount of energy as they consume). Also, the whole building stock requires gradual renovation and the switching of boilers and hot water supplies from using fossil fuels to renewables.

2.2.2 WHAT BENEFITS WILL UKRAINE GAIN FROM BUILDING DECARBONISATION?

Along with cutting GHG emissions, a lowered level of toxic gases in buildings, and enhanced energy security for Ukraine (by reducing the general demand of energy (especially in the cold season), households and owners of public/commercial buildings will also improve their living/working conditions and save money. The Energy Community estimates that for every percent of energy resources saved, Ukrainian residents would save EUR 89 million per year.

2.2.3 WHAT WILL IT COST?

In 2020 the Energy Community calculated that reducing energy demand by 61% per m² would cost about EUR 100 per m². Thus, annual expenditures on thermal retrofitting will reach EUR 1.3 billion (including thermal modernization of both buildings with CHS and those without it). Once modernized, a flat would use only 39% of the energy previously required to get to the same room temperature.

Total residential building stock	Annual retrofitting rate	Annually retrofitted, m²	Costs per m²	Total annual retrofitting costs
1 billion m²	1.3%	13 million	EUR 100	EUR 1.3 billion

Currently, investments are being financed by private households, supported by the Warm Loans Programme and the Energy Efficiency Fund. Support for these financial mechanisms is provided by international donors, foreign governments and international financial institutions.

In 2020, under the Warm Loans Programme, EUR 13 million was given in grants to attract overall investment of EUR 35 million (in 2019, EUR 20 million provided). Thus, every euro invested attracts two additional euros from private investors or households.

The Energy Efficiency Fund managed to accumulate even more funds – UAH 1.5 billion in 2020 (around EUR 50 million) – to be spent on energy-saving measures in residential buildings.

These numbers are promising, yet also demonstrate the need for substantial additional governmental support to achieve the targeted emissions reductions in the building sector.

Therefore overall expense will reach EUR 16 billion (EUR 13 billion for modernization). Additional investment is required to replace old boilers with new heating systems (around EUR 3.4 billion in 2021-2030).

This chapter of NDC does not envisage the modernization of the centralized heating system, boiler plants, and CHPPs presented in previous chapters of this document.

2.2.4 SECTORAL CHALLENGES

Along with the difficulties in the attraction of sufficient investments, other urgent issues arise in the context of the thermal retrofitting of buildings:

1. Household structures are often complicated, as house owners may not physically reside in a home, or several parties may own one house. It may be challenging to find a renovation compromise that suits everybody.
2. Due to subsidies, energy prices do not encourage citizens to take any energy efficiency measures – that is why these are often not beneficial to individual actors. In particular, subsidies for natural gas or centralized heating negatively impact the economic viability of retrofitting measures.
3. Information: residents may not even know about the amount of energy they consume each month due to a lack of meters and a lack of information on bills, along with the absence of information about potential energy consumption cuts that could be achieved by energy efficiency measures.
4. More and more consumers are shifting their heat supplies from centralized to individual systems. A consistent and transparent policy is required to encourage consumers to integrate into a centralized heat system, as it may be highly effective and has the potential to switch to renewable energy sources.

2.2.5 POLICIES AND MEASURES

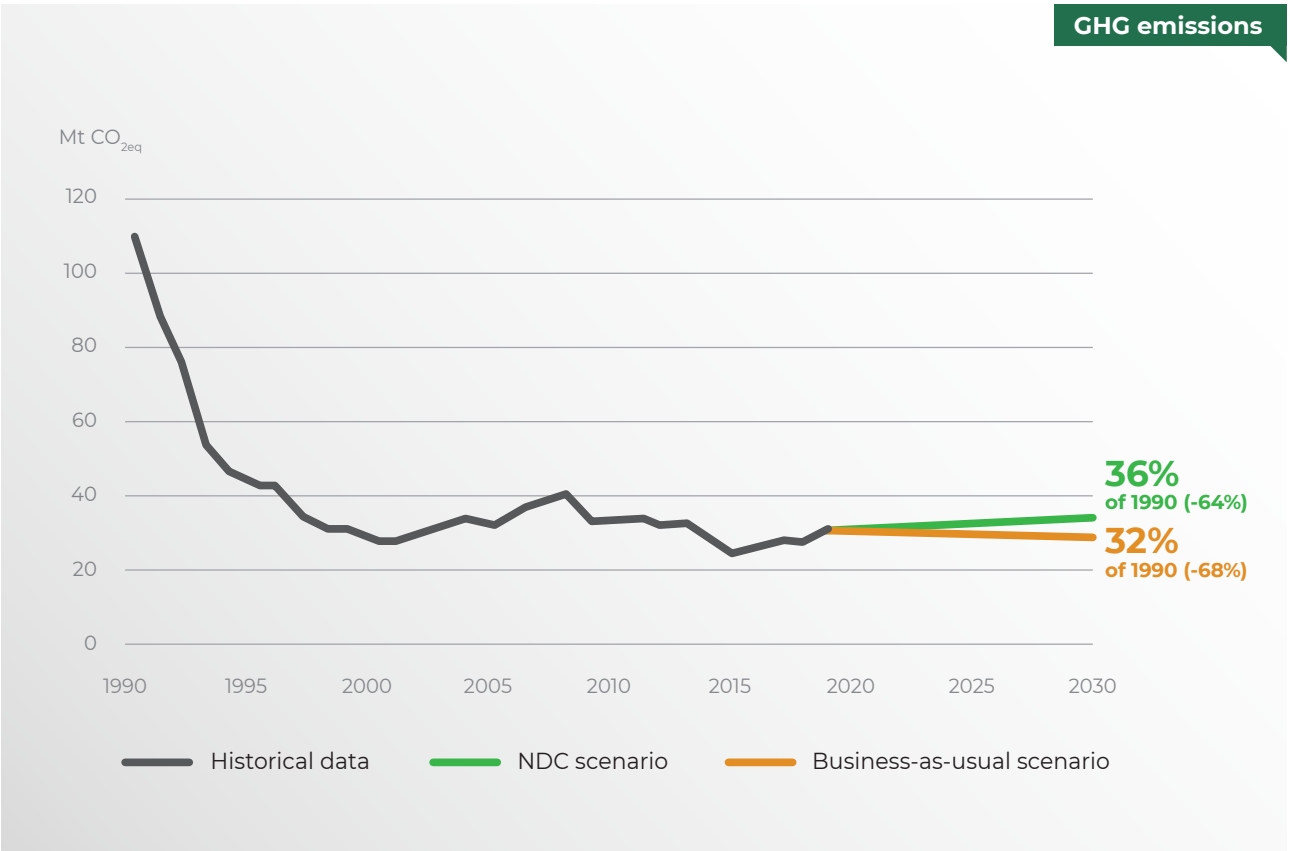
Several policies and measures are being planned and implemented to tackle the challenges above:

1. Meters are being installed to measure the energy consumed in residential buildings. E.g., around 81.7% of residential and non-residential buildings today are equipped with heat meters, while hot water meters are installed in 20% of residential buildings.
2. Databases on energy consumption are being introduced to inform residents about the amounts of energy used.
3. A system of "building energy certification" is being established so that residents, potential buyers or investors can be aware of how much energy is consumed in a building/flat, and how energy-efficient it is.
4. The establishment of residential building co-owner associations is being encouraged, and the process of joint decision-making and energy efficiency measure implementation is being promoted.
5. The centralized heat supply, which could be highly efficient and can be switched to using renewable energy sources, is being promoted.
6. Mandatory implementation of energy management systems by public executive authorities (national and local levels) and local governments.
7. Maintaining a register of residential and non-residential stock facilities (construction year, technical conditions, form of ownership, etc.).
8. Encouraging an increase in the share of new buildings with “green walls” and “green roof”.
9. Financial incentives:
    a. State-owned Energy Efficiency Fund enterprise – annual investment must grow from the current UAH 0-1.6 billion to at least UAH 7 billion annually by 2030;
    b. The Warm Loan programme;
    c. The programme in the framework of the "Energy Efficiency in Public Buildings" project (Ukraine and EIB)
    d. Green bonds to support the energy-efficient modernization of buildings, offering sufficient options for high-scale projects and private investors. However, state expenditures will be necessary to support green bond financing.
10. A set of various financial incentives for building owners and international donors/investors.
    a. Homeowners:
        i. State programme for co-financing energy efficiency measures for individual residential buildings;
        ii. Establishment of a state municipal revolving fund;
        iii. Replacing utility service subsidies with investments in energy efficiency measures for low-income citizens, and individual support for low-income residents.
    b. International investors:
        i. Further investment involvement via international financial agreements;
        ii. Market mechanisms to be established in the heating energy sector.

2.3 TRANSPORT SECTOR

ROAD, RAIL, AIR, WATER, GAS PIPELINES, OFF-ROAD (agricultural and military transport)

In 2018, this sector emitted 35 MtCO2e in total (71% road transport, 12% gas transporting and 17% off-road transport). Compared to the former, air, rail and water transport are minor emitters. NDC expects the GHG emissions level to stay under the threshold of 40.2 MtCO2e in 2030 (transport sector) at 36% of 1990's level. To achieve this goal, it is necessary to ensure that overall expenses in this sector by 2030 are at least EUR 3 billion (state subsidies, e.g. for the development of the electric vehicles market, but do not include the expenses on the purchase of private and public transport (requires further calculation).



2.3.1 WHICH ARE THE KEY TRANSFORMATIONS IN THE TRANSPORT SECTOR?

Domestic transport sector emissions are mainly generated by three primary sources: (1) road transport, including private motor vehicles, buses and trucks, (2) off-road transport (agricultural or military vehicles), and (3) gas-fuelled pumps for transporting natural gas in pipelines.

Considering that most people in Ukraine live in cities, it is important to develop attractive and environment-friendly alternatives to road transport such as safe and comfortable public transport and micromobility, which would promote GHG emission reduction. In public transport development, electrical transport should be prioritized: tramways, trolleybuses, urban and suburban railways.

To Ukraine, developing railway communications is reasonable to reach at least 15% of the country's total passenger traffic by 2030, that being twice as much as in 2016. Besides, it is worth ensuring stimulation of railway freight traffic development.

NDC does not project any changes in off-road transport, as the engines used in the relevant large vehicles are still significantly cheaper than carbon-free technologies. Therefore, measures to lower GHG emissions will relate mostly to road transport and gas transporting. For the amount of natural gas leakages into the atmosphere, it is necessary to consult the supply sector analysis.

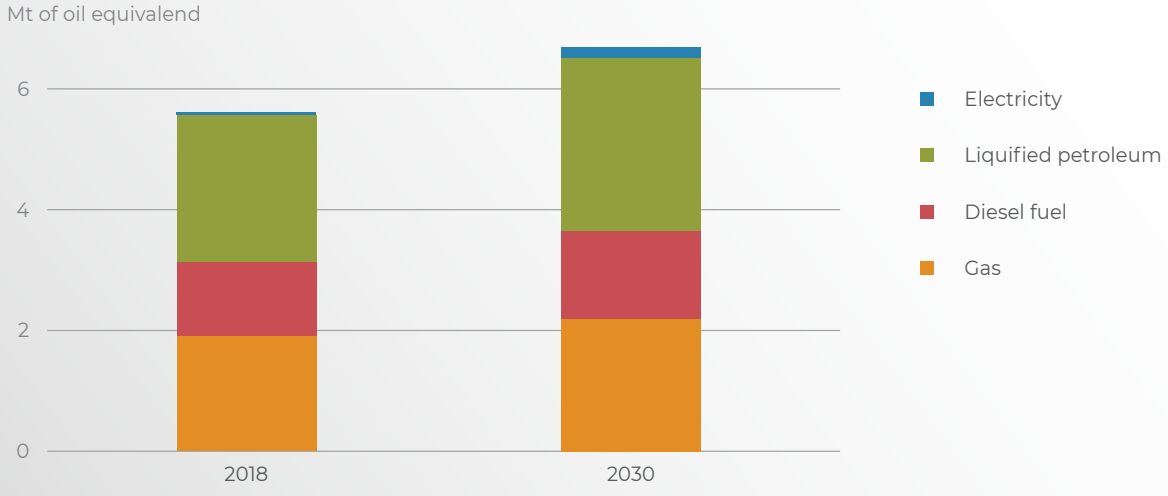
ROAD TRANSPORT

According to the MIA Central Service Centre, about 13.76 million motor vehicles were registered in Ukraine as of 1.10.2020, including about 12 million owned by natural persons. Around 43% of these motor vehicles were manufactured in 1999 and earlier. Out of the total number of motor vehicles, about 50 thousand are electric ones (including hybrids).

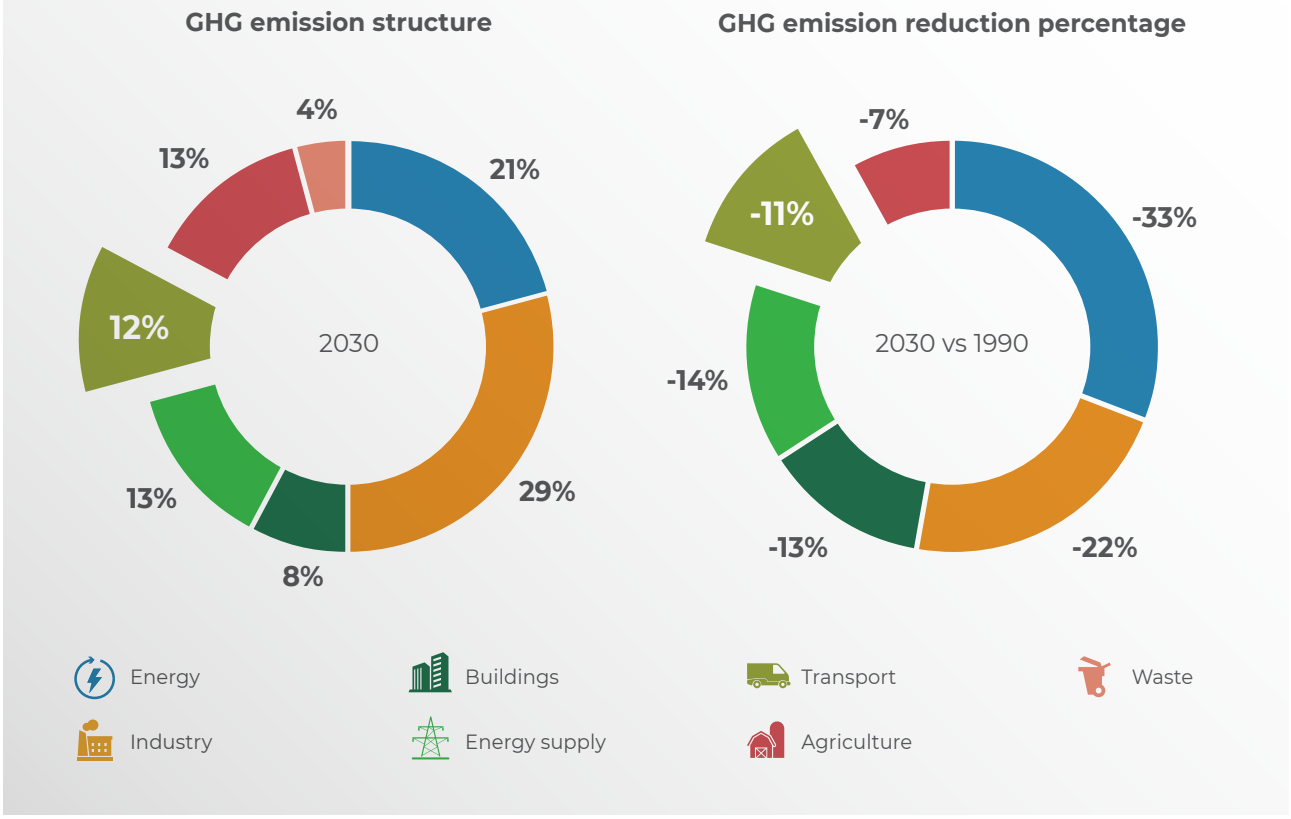
Three basic drivers for reducing GHG emissions from road transport:

1. Cutting the total number of kilometres travelled (usually related to reducing the number of vehicles in a country).
2. Changing the fuel propelling the vehicles, e.g., electricity instead of diesel ("fuel switching").
3. Reducing the amount of energy consumed per kilometre ("energy efficiency").

Energy consumption by transport



Emissions



As low-carbon technologies used for large vehicles such as trucks and buses are not yet competitive, no full fuel switch for large vehicles will occur by 2030 (it may slowly evolve). Therefore, this chapter focuses primarily on motor vehicles. However, after 2030, a fuel switch for large vehicles will become relevant, as this mode of transport accounts for about 45% of all GHG emissions from road transport. Besides, new manufacturers of motor vehicles using electric power to charge batteries will contribute approximately 30 TWh of electricity generation.

According to the optimistic forecasts for annual GDP growth (more than 3% annually), vehicle numbers will increase by about 3% every year, with obsolete transport being replaced by new models. By 2030 there will be 9.3 million motor vehicles in Ukraine (there were 7 million in 2020). Approximately 90% of the Ukrainian motor vehicle fleet in 2030 will be comprised of old transport models and imported ones. There will be a gradual switch from the use of fossil fuels to electricity. It is expected that battery-powered electric vehicles will comprise about 3% of the domestic light motor vehicle stock in 2030.

This trend means the initial target set by the "Transport Strategy of Ukraine" (a 50% share of RES in transport in 2030) will not be achieved, but it is still a pragmatic first step towards a fuel shift in this sector.

Despite this slow fuel switch process in the light motor vehicle segment, total emissions from motor transport will grow by 21% – such a rise mainly driven by the overall increase in cars.

In the long-term perspective, all passenger cars, trucks and buses must be replaced by more efficient vehicles powered by electricity or other low-carbon technologies.

GAS TRANSPORTATION

Currently, the compressors that pump natural gas through domestic pipelines are mostly powered by using the gas itself, generating annual GHG emissions of approx. 3 $MtCO_{2eq}$. Replacing gas-powered compressors with more efficient electricity powered ones would save energy, lower emissions, and cut both fuel and labour costs, as electric compressors are more easily maintained and repaired. Electric compressors have a propulsion efficiency of up to 95%, whereas for gas-fuelled technologies this is 55%. One should also take into account and compare the number of places that natural gas leaks into the atmosphere in the section on the gas transport sector.

2.3.2 WHAT BENEFITS DOES UKRAINE GAIN FROM TRANSPORT DECARBONIZATION?

Reducing the GHG emissions generated by road transport would also help lower the share of several toxic gases such as NOx, SO2 and PM2.5 (major triggers of cardiovascular and lung diseases).

Additionally, switching fuels from gasoline and diesel to other sources of energy would make the state less dependant on imported oil (currently supplied mostly by the Russian Federation).

2.3.3 WHAT WILL IT COST?

ROAD TRANSPORT

Electric cars are currently are more expensive (by around EUR 13,000) than conventional vehicles. Thus, to achieve the 3% share of electric cars as envisaged, EUR 2.8 billion would have to be spent between 2020 and 2030, or 5% of projected expenditures on conventional vehicles. It must be noted that the amount of investment in the transport area includes only state subsidies or tax exemptions designed to achieve a 3% share of private electric vehicles by 2030 or at least 10% of the newly registered motor vehicles. The share of electric vehicles in motor car sales can reach 19.4% in 2030, whereas the share of electric buses in sales will be at least 4% in the same year.

The overall expenditures envisaged seem ambitious, as recently Ukrainians have spent probably only around EUR 1 billion per year on purchasing vehicles. Only a part of that was spent on passenger transport.

The high price of electric vehicles, however, is more than compensated for by its low running costs – UAH 15 000 can be saved annually on fuel expenditures.

Investments in the modernization and decarbonisation of public, rail and water transport require additional calculations, but will clearly result in GHG emissions reductions additional to those foreseen in the transport chapter of NDC.

The total amount of natural gas leakages into the atmosphere is discussed in more detail in the in energy supply section.

2.3.4 SECTORAL CHALLENGES

The Ukrainian electric vehicle market requires the development of relevant infrastructure (charging stations). Currently the total cost of owning and running conventional vehicles is still lower than that of electric ones. Therefore, in the short-term perspective the development of the electric vehicle market will not be possible without additional support and incentives. Still, technologies are rapidly evolving, and according to the results of international studies by 2025 the capital and operational expenses of conventional and electric vehicles may be equal.

Today's domestic passenger transportation system is becoming more car-centred. Shifting the focus from private passenger transportation towards public transport will reduce future energy demand. However, in the short-term perspective, the public transport system might require substantial additional funding at the national and local level, rather than just the introduction of updated vehicle standards.

2.3.5 POLICIES AND MEASURES

Several policies and measures to tackle the aforementioned challenges are already in the process of preparation and implementation:

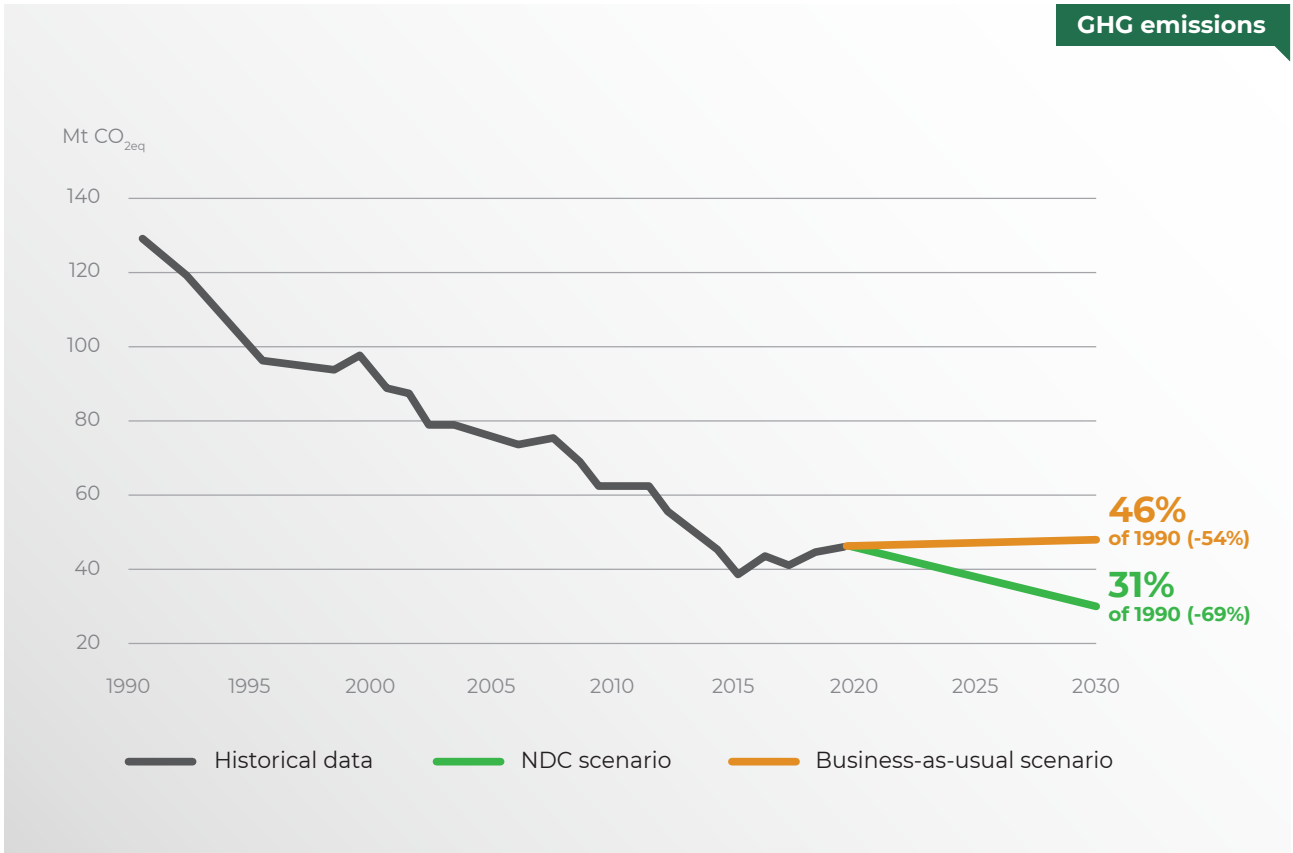
1. Establishing, monitoring and enforcing emission standards, and the introduction of:
   - more stringent emission standards for newly-registered vehicles, especially Euro-6;
   - a car registration fee (cancelled in 2014) in accordance with its level of GHG emissions;
   - an environmental tax or excise tax on fossil fuels for motor vehicles (cancelled in 2014);
   - a toll and incentives system for road users depending on the level of GHG emissions;
   - regular car inspections following the Directive on Roadworthiness tests for motor vehicles and their trailers;
   - labelling of vehicles according to their emission standards and energy consumption levels.
2. Promotion of public transport:
   - support for the modernization of the public transport fleet and the development of the relevant infrastructure (with the allocation of at least 30% of the local transport budget);
   - mandatory development of sustainable mobility development plans at the city level.
3. Support demand for electric vehicles (EVs):
   - introduction of further benefits for EV buyers would help stimulate demand for private electric cars;
   - support the construction of new charging stations for EVs.
4. Support the switch of freight transportation from Ukrainian roads to more environmentally-friendly railway and water transport routes;
5. Set sustainability goals and criteria for the use of biofuels on the Ukrainian fuel market;
6. Introduce a system for recycling old cars;
7. Improve the system of statistical data collection and methods for calculating the GHG emissions generated by the transport sector.

2.4 ENERGY SUPPLY SECTOR

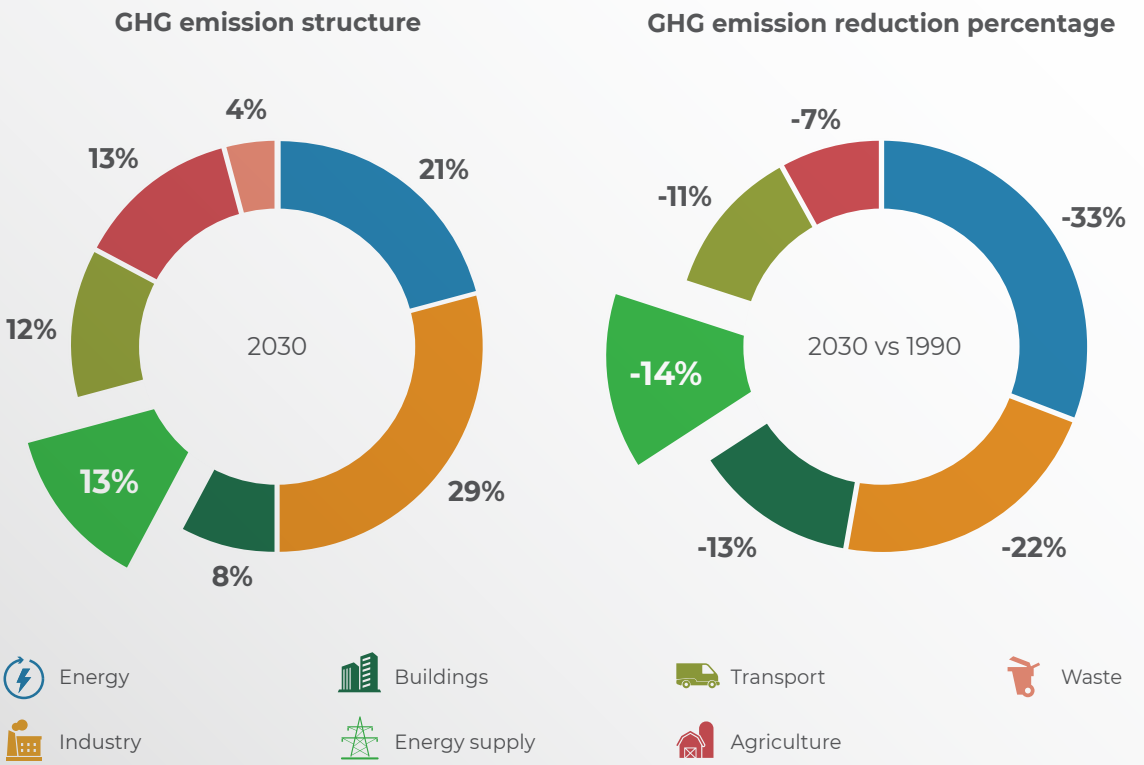
EMISSIONS FROM FOSSIL FUEL EXTRACTION, PROCESSING, TRANSPORTATION AND STORAGE

In the energy supply sector, GHG emissions have been continuously declining over the past 30 years, reaching 46 $MtCO_{2eq}$ in 2018, which corresponds to a 64% reduction compared to 1990 emissions. NDC targets emissions at the level of 40 $MtCO_{2eq}$ in 2030, or 31% of 1990 emissions (-69%). The share of the energy supply sector in the overall emissions reduction goal is 14%. To achieve the expected GHG emissions cut, EUR 8 billion will have to be spent in 2021-2030.

GHG emissions



Emissions



2.4.1 WHAT ARE THE KEY TRANSFORMATIONS?

Emissions are generated by this sector in the course of extracting, processing, transporting and storing coal, oil or gas. In 2019, losses of natural gas during transport comprised around 20% of total domestic emissions, most of which was methane. While in the 1990s half of state GHG emissions originated from solid fuels (coal) and half from oil and gas, nowadays coal accounts for only one third of these emissions. Today the majority of GHG emissions from the sector (65%) are generated by natural gas (half during transportation, and around 20% during the extraction process). The remaining emissions from natural gas occur during exploration, processing and storage.

Energy supply emissions are therefore strongly connected to coal mining and natural gas production, as well as its consumption. In the long-term perspective, the amount of GHG emissions, related to energy resource extraction will be substantially affected by the phasing out of coal and mine closures. However, the issue of methane accumulation in abandoned coal mines will still have to be considered.

It is expected that by 2030 biofuels and hydrogen will not be prioritized in this sector. NDC foresees a reduction of primary coal consumption of around 50% compared to 2019, whereas the total primary gas supply is projected to increase by 20%. Moreover, natural gas infrastructure (transportation and supply) will be modernised to increase the efficiency of natural gas supplies and to reduce leakages at all stages. Ukraine has set the target of cutting natural gas losses during transportation by 80% compared to the 2015 level.

2.4.2 WHAT ARE THE BENEFITS TO UKRAINE?

Reducing emissions in the energy supply sector does not only have a positive climatic impact but also helps to minimize waste (losses) of energy resources and enhances safety by addressing pipeline leakages. Moreover, management of coal-bed methane helps to stop dangerous build-ups of natural gas in mines, and prevent explosions.

2.4.3 WHAT IS THE COST FOR UKRAINE?

To achieve the NDC targets, around EUR 8 billion will be required for investment in oil and gas pipelines over the next decade. Such investment can be introduced, for example, within existing tariff rates or by using borrowed funds. However, this would require setting tariffs at a rate high enough to cover costs, to ensure enough manoeuvrability for investments. Additional funds would have to be invested in liquid biofuel infrastructure to enable the expansion of biofuel use in other sectors.

2.4.4 SECTORAL CHALLENGES

Ukraine's mostly out-of-date coal mines require the introduction of modern coal-bed methane management, regardless of whether they are subject to closure or not. Regulations and incentives for public and private mining operators are not yet in place.

The natural gas sector suffered from underinvestment and tariffs set at below cost-covering levels in the past. As a consequence, 60% of domestic gas networks are depreciated, and thus transportation as well as distribution losses are very high compared to European standards. The Ukrainian energy regulator introduced a more favourable regulatory environment for distribution companies, but a lack of legal certainty, overregulated tariffs, a lack of access to international finance and limited incentives for investment are still holding up the modernization of energy supply sector.

2.4.5 POLICIES AND MEASURES

Compared to other sectors, where goals are clearly defined by legislation (e.g. energy efficiency in the building sector) no such well-regulated targets are envisaged for the energy supply sector.

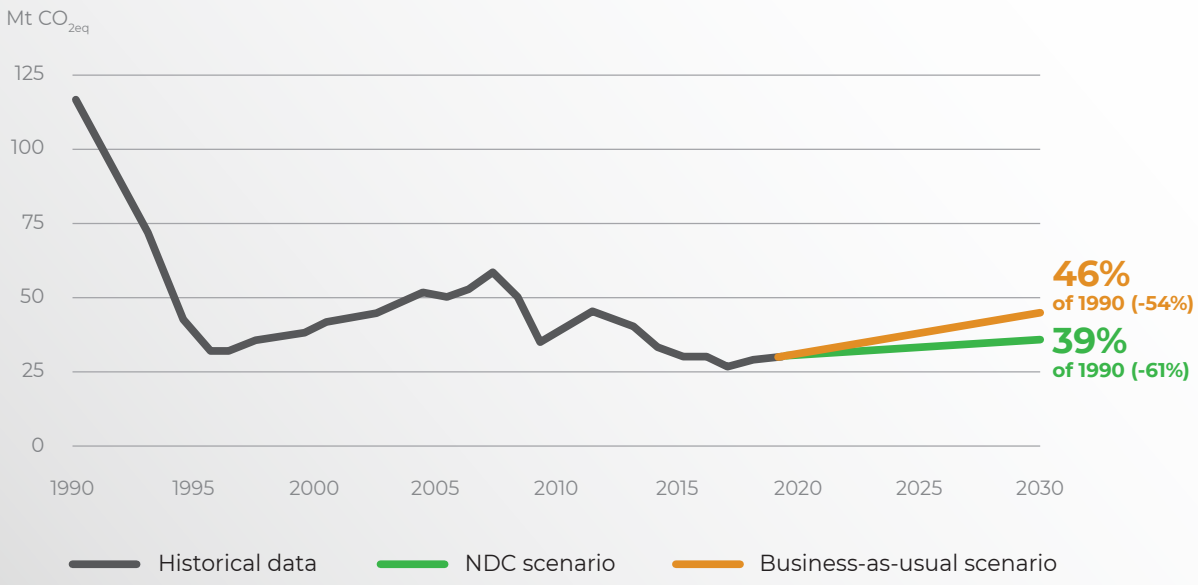
Ukraine could introduce measures to prevent leakages during the extraction and processing of coal, natural gas and, to a lesser extent, oil, including preventive maintenance. First, the state must introduce a robust monitoring and reporting system for methane emissions, with regular inspections to identify vulnerabilities along the supply chain, and incentivize maintenance measures. Additionally, natural gas price subsidies must be cancelled to ensure gas companies can operate effectively, covering their costs. Gas distribution companies must take on responsibility for making the required investments. Finally, responsibility for preventing GHG emissions from closed oil wells, gas fields and coal mines must be clarified and clearly allocated.

2.5 INDUSTRY SECTOR

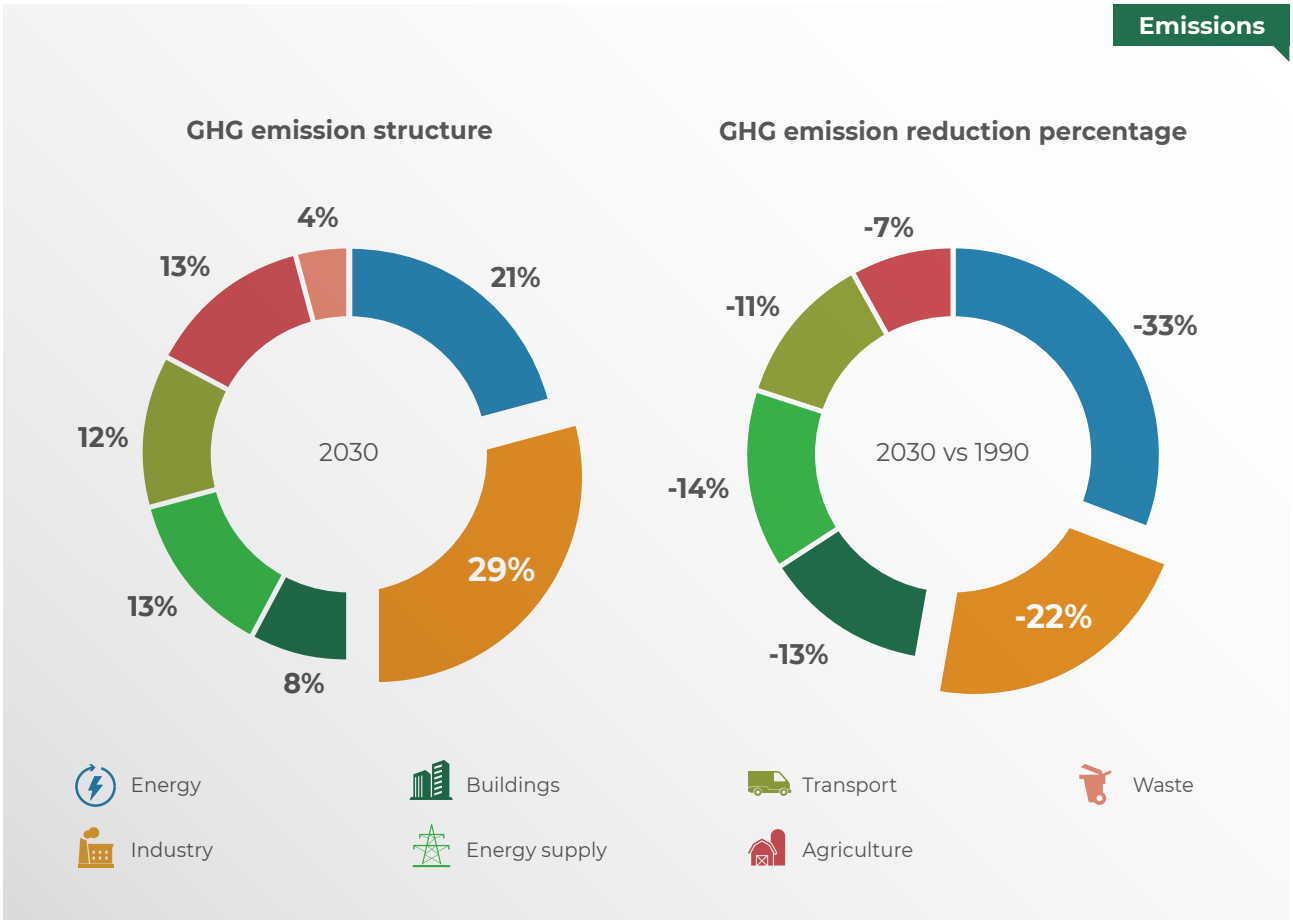
INDUSTRIAL PROCESSES AND FUEL COMBUSTION IN MANUFACTURING INDUSTRIES AND CONSTRUCTION

In 2018 industry generated 75 $MtCO_{2eq}$ of GHG emissions (-66% compared to 1990). NDC foresees an emission increase to 89.5 $MtCO_{2eq}$ (-61% of 1990 levels) by 2030, accounting for 22% of the country's overall emissions reductions. In comparison to 2019, the GHG emissions level will grow by 16%, driven by annual economic growth of 3.8%, although an average annual (gross) efficiency improvement of 1.5% in the industry sector will prevent a greater increase in GHG emissions. To keep the industrial emission limit within 16%, the maximum necessary investments will amount to about EUR 37 billion during 2021-2030.

GHG emissions



Emissions



2.5.1 WHAT ARE THE KEY TRANSFORMATIONS IN INDUSTRY?

The increase in GHG emissions by industry will be driven by the further economic development of Ukraine; on the one hand, expanded economic activity boosts energy consumption and, on the other hand, higher incomes attract more green investment.

Domestic GDP is projected to grow over the next decade (annual growth rate of around 4%), while different sectors will demonstrate different growth dynamics. Higher growth rates are expected in the construction and manufacturing sector, whereas lower growth rates are expected in the metallurgical industry. National forecasts foresee that by 2030 industry will recover to its 2013 level. Deeper structural changes in goods and services output are expected to be more visible after 2030.

NDC foresees that by 2050 electricity will account for more than half of the energy used by industry – compared to 25% in 2019. New technologies will not only allow reductions in the use of carbon-intensive energy sources, but will also make the use of energy in production more efficient. The introduction of new technologies will play a vital role, especially in the most energy- and carbon-intensive industries – metallurgy and cement making.

However, by 2030 fuel switching will play a minor role in reducing industry's GHG emissions. The share of electricity used in industry is expected to reach 30% in both scenarios (business-as-usual and NDC). The sectoral emissions target of 89.5 $MtCO_{2eq}$ is based on an annual (gross) efficiency improvement of 1.5%.

2.5.2 WHAT ARE THE BENEFITS FOR UKRAINE?

The decoupling of sectoral economic growth and energy consumption will result from capital fund modernization (machinery, buildings), along with the adaptation of production processes and reformatting of production lines. All these processes push structural changes, which will improve the sector's competitiveness in an international context, contributing to the revival of the state's economy. In this case, structural changes and a modernized industry will boost FDI. Consequently, Ukraine's trade balance will be affected positively. Additionally, the shift to decarbonized production processes may also help prevent Ukraine being impacted by the carbon border adjustment mechanism of the EU and, presumably, by similar "carbon taxes" of other states.

Along with these economic effects, we may also expect local and regional positive impacts on the health of citizens residing close to large emitters of GHGs and other pollutants.

2.5.3 WHAT IS THE COST FOR UKRAINE?

To achieve a GHG emission reduction of 61% compared to 1990, the sectoral investment flow must increased with the use of appropriate financing mechanisms. Over the past five years approximately EUR 2.5 billion has been invested annually by Ukrainian industrial objects (excluding the mining and energy industries) in their modernisation.

The type of funding sources used by companies in the industrial sector for investments will depend on the business segment they occupy, the maturity of the business model, and/or the company and its profitability. Credits will be appropriate to fund investments to replace and expand physical capital funds. Regarding bank loans, corporate (green) bonds, issued by companies planning investments, will be of special interest. Still, in this case (as well as for all debt-based financial products) the shareholder structure is not affected, but equity capital will change this structure. The respective advantages and disadvantages of any financial product depend on a variety of factors, but for all investments there is one established rule: companies and their business-models have to be viable, otherwise access to capital is denied.

Maximum aggregate expenditures (calculated by the "Institute of Economy and Forecasting of NAS of Ukraine" in the process of modelling) were taken as the indicator of the overall investment required to achieve the NDC target, as the model does not allow the calculation of separate components. The maximum amount of investment in industry is up to EUR 37 billion in 2021-2030. It must be stated that these figures are exaggerated, as NDC target stipulates a corrected (upwards) total GHG emissions level.

2.5.4 SECTORAL CHALLENGES

Compared to the residential sector, there has been insufficient progress in achieving energy efficiency improvements in the industrial sector in recent years. Currently no explicit policy measures exist to stimulate modernisation and boost energy efficiency of industrial enterprises. Modernisation would definitely improve the sector's competitiveness, but still it demands high up-front costs. Additionally, the turbulent investment climate in Ukraine makes it even harder for the sector to attract funds. While investments may partly be supported by carbon emission tax revenues (e.g. by government-backed loans), tax revenues are not directly allocated to energy and climate measures, but go to the general budget under the principle of general budget allocation. Moreover, we need to evaluate whether the envisaged carbon tax increase (to UAH 30/tCO2 (EUR 0.9/tCO2) by 2024 is sufficient to ensure the additional required investments are used as intended.

2.5.5 POLICIES AND MEASURES

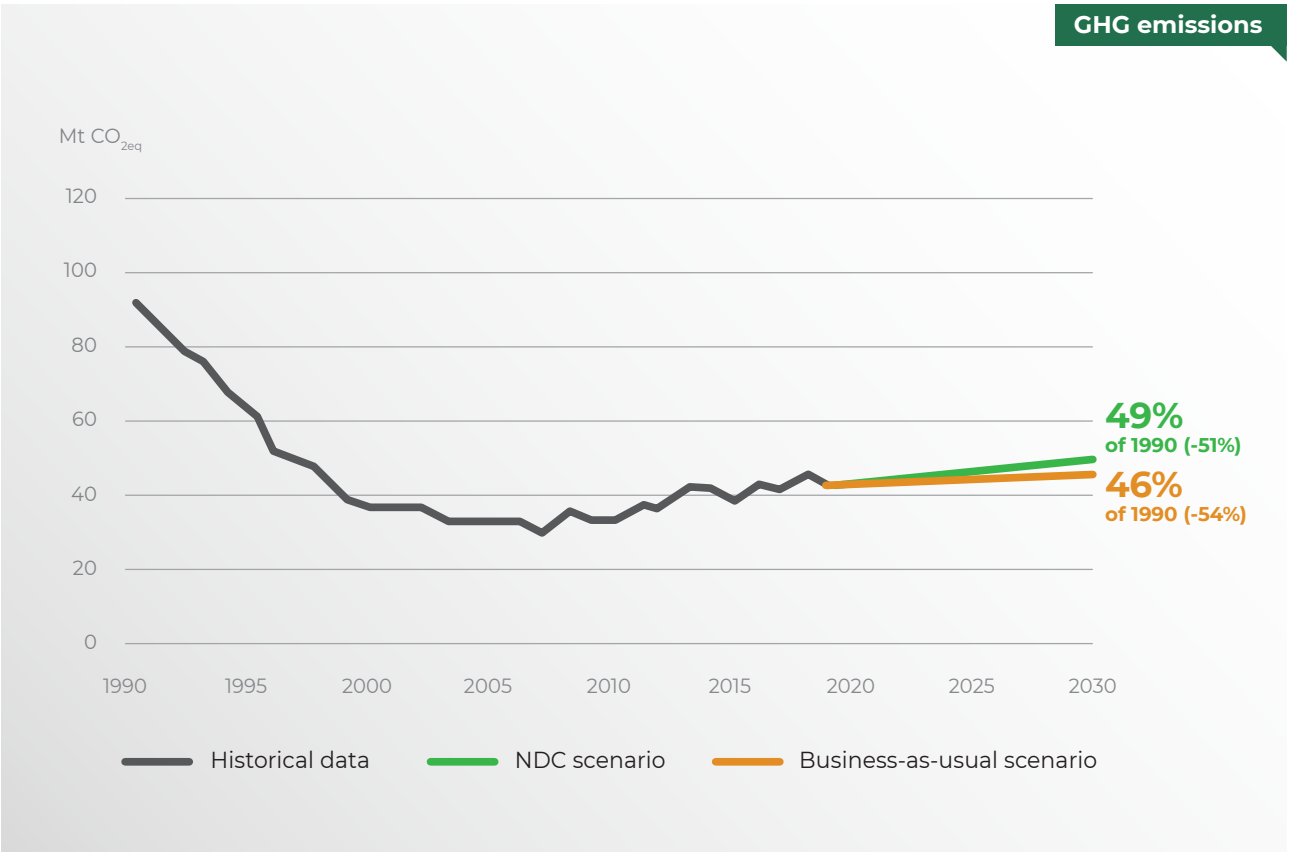
Existing/planned policies and measures aimed at stimulating the decarbonisation of Ukrainian industry include a greenhouse gas emissions monitoring, reporting and verification (MRV) system, the introduction of a greenhouse gas emission quota trading system (in 2025-2027) as well as the introduction of integrated emissions permits in accordance with the best available technologies (2024).

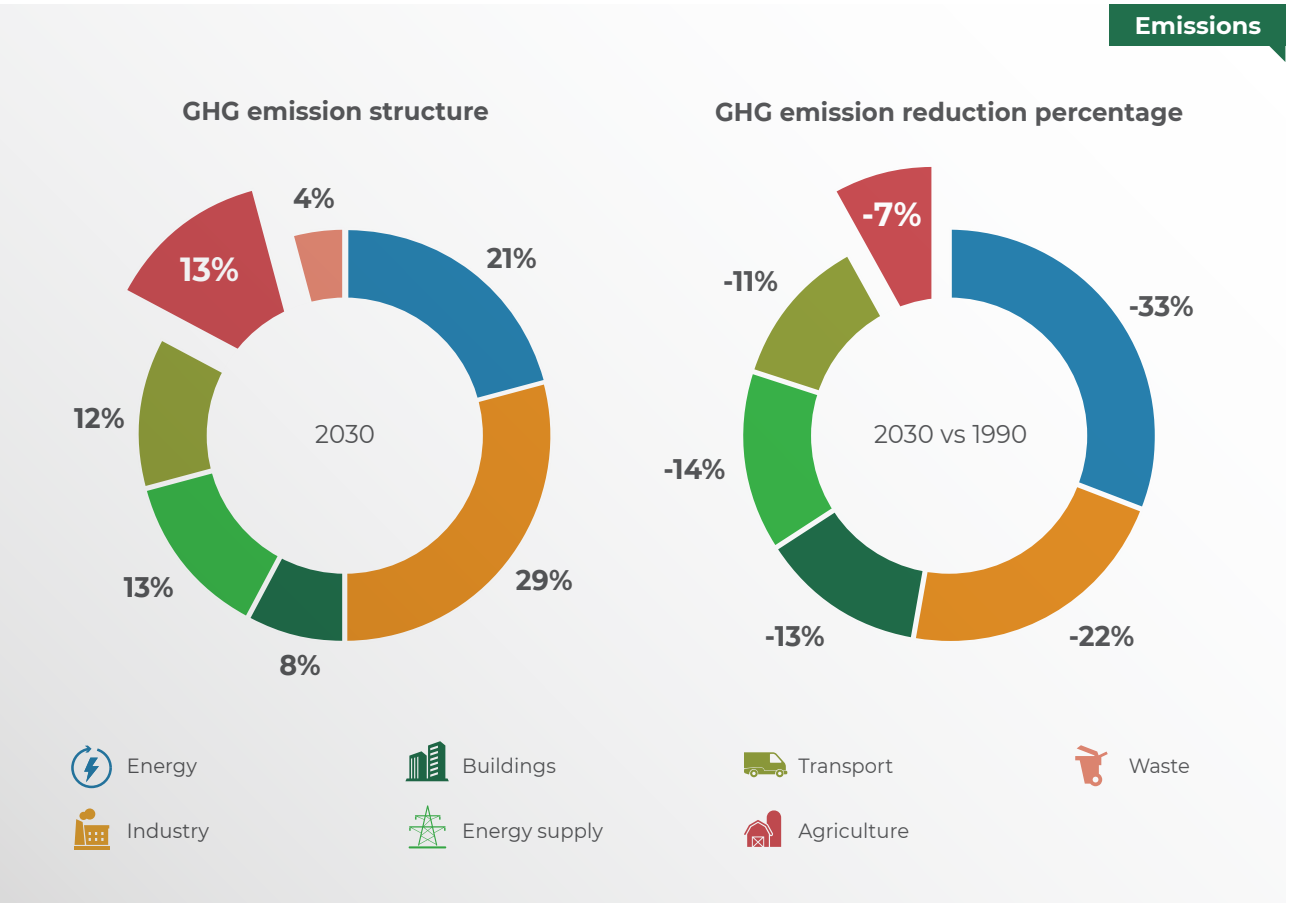
Moreover, the draft National Action Plan on Energy Efficiency 2030 envisages that energy efficiency levels may be increased by introducing financial incentives for industrial enterprises, modifying the current CO2 tax, and using funds accumulated from the CO2 tax for soft loans to implement relevant measures. This goal may also be achieved by introducing energy service contracts to be concluded between business owners and ESCOs, with clearly defined industrial energy performance contracts and an ESCO financing system. This could be supported by creating a scheme of "voluntary agreements" under which companies that perform well would be able to receive as a bonus public support in the form of technical assistance, or access to funding and interest rate subsidies.

2.6 AGRICULTURAL SECTOR

AGRICULTURAL SOIL, INTERNAL FERMENTATION, MANURE TREATMENT

In 2018 the agricultural sector generated 44.2 $MtCO_{2eq}$ of GHG emissions (-49% compared to 1990; +10% compared to 2015). NDC foresees that sectoral emissions will amount to 44.5 $MtCO_{2eq}$ by 2030, which is +0.6% compared to 2018 (+4.7% compared to 2019) and +51% compared to 1990. Reaching this level will require approximately EUR 2.3 billion of aggregate expenditures in 2021-2030.





2.6.1 WHAT ARE THE KEY TRANSFORMATIONS?

The largest increase in the level of GHG emissions has been observed in the "Agricultural soil" subcategory. Compared to 1990, GHG emissions in this subcategory decreased by only 11.1% compared to 1990, and compared to 2017 they increased by 12.7%. This trend may explained by the expansion of arable lands and the intensified use of mineral fertilizers, which have almost completely replaced organic compounds.

Ploughing indicators in Ukraine have already reached the top of the global rating, so further development in this sector is possible only by increasing efficiency with new technologies and fertilizers, which will also help to reduce GHG emissions. A range of climate protection policy measures must be taken, including the popularization of soil-friendly tillage techniques to retain moisture and organic substances; the application of sustained release fertilizers; increasing the share of lands under organic products; strengthening controls over illegal ploughing of pasture and protected water areas; the restoration of windbreaks; observance of crop rotations; and the construction of biogas-fuelled power stations for manure utilization.

According to statistical data, there are about 8 million hectares of degraded land in Ukraine, some of which are marginal for agricultural activities. In practice, firms all over the country have already encountered a gradual decline in land productivity a decrease in the average yield of some crops. By now, some farms have already been shifting to new production business models such as the expansion of horticulture, enlargement of areas under nut crops, use of agroforestry enhancement practices, growing of perennial spices, essential oil crops and medicinal herbs, etc.

According to the data from the State Statistics Service of Ukraine, the use of mineral nitrogenous fertilizers in Ukraine demonstrates a gradual upward trend, totaling 1.6 million t of nitrogen in 2019. It is expected that the amounts of use of mineral fertilizers will keep growing due to the expansion of agricultural land areas whereas the effectiveness of such fertilizers will increase by 10%.

Animal farming emissions (from internal fermentation and waste treatment) will keep decreasing due to better animal farming waste management practices and further development of the technology of biogas production from animal farming waste.

2.6.2 WHAT ARE THE BENEFITS OF UKRAINE?

Agricultural activities have a considerable potential for GHG emission reduction and carbon sequestration due to the introduction of sustainable agricultural practices that allow the organic carbon content to increase.

In addition to GHG emission reduction and expansion of the lands under organic production, inclusion of support to organic agricultural goods producers in the state programme for 2021-2023 enables ensuring that the area of land having the organic status will amount to 3% of the total agricultural land area by 2030. Besides,there are other advantages, namely higher farming business efficiency, the protection of soils and waters, and the conservation of biodiversity, which cannot be measured only by reduced GHG emissions. Boosting organic production will also provide additional export opportunities.

Besides, supporting land protection activities, restoring windbreaks, supporting recovery and return of 1-3 million hectares of degraded land to natural ecosystems will promote achieving an additional GHG emission reduction.

The increase of mineral fertilizer treatment will be restricted more strongly by reduction of the existing moisture in soils emerging due to climate change. The technologies aimed at preserving soil moisture will positively impact reduction of greenhouse gas emissions and adaptation to new climatic conditions.

Using green manure and cover crops in plant growing, improving soil productivity and enriching soil with nitrogen with the aid of nitrogen-fixing crops, reducing application of herbicides gradually, and preserving soil moisture also positively impact GHG reduction. Although the above-mentioned technologies are underdeveloped in Ukraine, they can potentially increase utilization subject to adequate support and dissemination.

Improving and enhancing soil quality monitoring, using information technology, applying mineral fertilizers on a variable basis, and adhering to agricultural best practices in fertilizer management should avoid any further growth of emissions from agricultural soil and ad achieving their gradual reduction.

2.6.3 WHAT IS THE COST FOR UKRAINE?

The overall sectoral investment required to implement the HDC2 scenario is EUR 2.3 billion, but this comes with a number of other benefits, such as ensuring the achievement of SDGs, improving living conditions, better protecting soil and water, conserving biodiversity.

Ukraine has already introduced certain support systems for the agricultural sector:

- state support through surcharges in favour of insured persons – the members / chairpersons of FFEs;
- state support for the development of stock raising and processing agricultural products;
- partial compensation of expenses (agricultural machinery and domestically made equipment);
- financial support for measures in the agroindustrial complex through reducing the cost of loans.

NDC implementation requires the integration of its GHG emission reduction targets with existing targets, and the introduction of new regulatory and financial mechanisms in the agricultural sector. Besides, other important steps include increasing the funding for support of sustainable agricultural practices, particularly organic farming, and introducing new areas of support, in particular minimized tillage, using information technology, encouraging the introduction of energy-efficient and resource-saving technologies, supporting return and recovery of degraded land, and restoration of windbreaks. Integration of environmentally-friendly technologies in agriculture as a requirement to receive state support may be an efficient mechanism.

2.6.4 POLICIES AND MEASURES

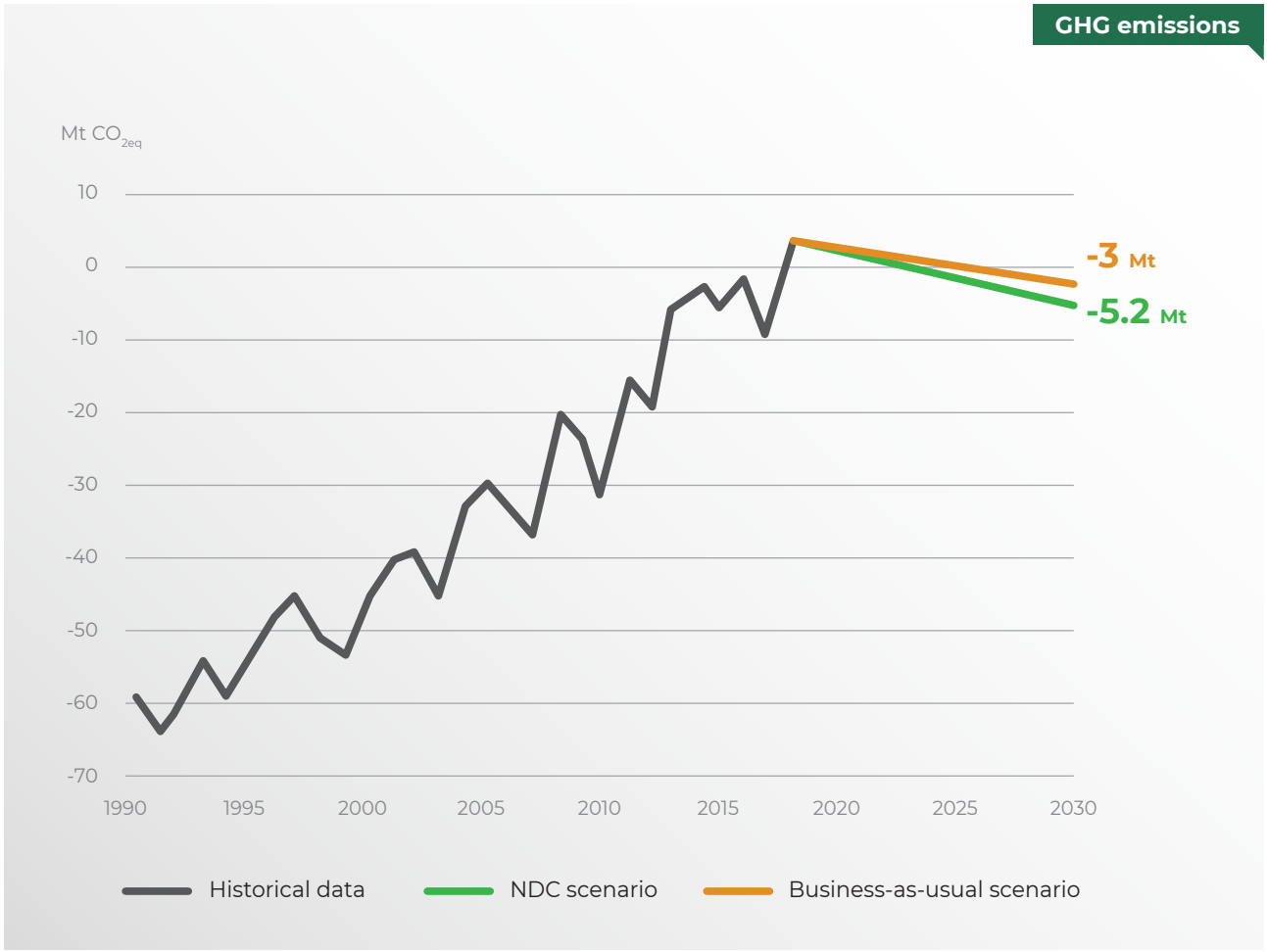
To achieve the NDC national target, a number of policies and measures have been designed and are already being implemented:

- introduction of minimized tillage techniques and a ban on stubble burning in fields;
- support for land protection activities and the restoration of windbreaks;
- harmonization of domestic regulations (distribution and use of pesticides and agrochemicals) with EU legislation;
- introduction of the best agricultural practices for zones vulnerable to nitrate pollution;
- support for returning and restoring degraded land (purchase by state or payment for decommissioning);
- supporting the use of manure at all stages: production, processing, storage, transportation and application, and its utilization in biogas production;
- supporting development of organic agriculture and observance of crop rotations

2.7 SECTOR OF LAND USE, LAND USE CHANGE AND FORESTRY (LULUCF)

WOODED LANDS, ARABLE LAND AND PASTURES, WETLANDS

Total GHG emissions generated by the LULUCF sector have been gradually increasing since 1990 - from a level of -21.5 million tons of CO_{2eq}. of GHG sequestration to the level of +0.3 million tons of net GHG emissions in 2019. Compared to 1990, the amount of GHG emissions absorbed by the country's forests has decreased by only 8%, while GHG emissions from arable land have rise steadily from 31.3 million tons of CO_{2eq}. in 1990 to 50 million tons of CO_{2eq}. in 2019. NDC proposes a total GHG emissions reduction of 9.4%, achieving a sectoral level of GHG emissions absorption of -9 million tons of CO_{2eq}. The cost of this goal is approximately EUR 3 bn (2021-2030).



2.7.1 WHAT ARE THE KEY TRANSFORMATIONS?

The share of forested lands in the forestry sector is planned to increase from the current 15.9% to 18% through the preservation of naturally forested lands and the use of degraded agricultural lands (in the relevant climatic zones).

The forestry sector requires systemic reform of its management, improvements to its regulatory framework, enhanced transparency and control over logging, as well as complete inventory of forestland. Since 2020, clear felling of all tree types in protected areas, erosion-prone areas, and high mountain woodlands in the Carpathian has been prohibited. Further reforms in the area of Ukrainian forest management must ensure the sustainability of forestry, extend the state forest coverage and, above all, improve the performance of the forest ecosystem's functions.

Ukraine's forestland is vulnerable to climate change. Recently, significant deforestation, pest infestation, and increasing frequency and intensity of wildfires has been observed. Therefore, in order to preserve forests and maintain the current level of GHG sequestration, it is necessary to switch to selective wood harvesting systems, introduce mixed crops during artificial reforestation, introduce innovative approaches to fire management, ensure the sustainable financing of fire-fighting measures in forestland and natural ecosystems, prohibit peat extraction from forested lands and restore drained and degraded wetlands within forested areas.

Ukraine must accelerate the pace of creation of nature reserves, as well as increase the number of areas granted the Emerald Network status, while ensuring their legislative regulation. Currently the share of nature reserve areas is at 6.8%, and must at least reach the level set by the State Strategy for Regional Development (15% of the total area). It is also necessary to ban the extraction of peat on lands with no previous extraction background, and restore wetlands degraded by peat harvesting.

GHG emissions from arable land and pastures largely depend on management practices and weather conditions. The application of significant amounts of organic fertilizers provided lower GHG emissions in the early 1990s. In 2018, only 5% of organic fertilizers were applied compared to the 1990 level, while for mineral fertilizers it was about 88%. In addition, the structure of cultivated crops has changed significantly. While there has been a slight increase in the share of cereals, the percentage of industrial crops (sugar beets, flax, hemp) fell significantly (35% → 10%). The share of oilseeds (sunflower, rapeseed, soybeans) has drastically increased (7% → 30%). Key technologies and policies applied to reduce GHG emissions envisaged by NDC are described in section 2.6.

2.7.2 WHAT ARE THE BENEFITS FOR UKRAINE?

Along with the reduction of GHG emissions generated by arable land and pastures, and the enhancement of GHG sequestration in forestry sector, Ukraine is also able to increase its forested areas, achieve SDGs, adapt to climate change, minimize flooding, conserve biodiversity and support the development of the tourism sector.

2.7.3 WHAT WILL BE THE COST FOR UKRAINE?

The LULUCF sector requires EUR 3 billion in investment to implement the NDC scenario, but this amount does not include the value of land for conversion into natural ecosystems – meadows, steppes, and forests.

The price of the GHG emissions cut is approximately EUR 55/tCO2.

Ukraine currently has a certain system of forestry sector support in the form of a deduction of the part of the rental payment for the use of forest resources according to par. 15-1 Article 30(4) of the Budget Code of Ukraine.

The deductions go to a special state budget fund established for the forestry sector for tree planting and protecting forests from pests and fires.

To achieve the NDC nationwide target we also need additional regulatory and financial mechanisms, namely:

- Promotion of the conversion of degraded agricultural land into natural sites (forests, grasslands, meadows);
- Incentives for a shift to selective timber extraction techniques instead of clear felling;
- A ban on transferring forested lands to other forms of land use, except of cases of urgent public need, and provided that larger territories will be afforested to compensate for losses of forestland.

2.7.4 SECTORAL CHALLENGES

The following domestic challenges have been identified in the LULUCF sector:

- the allocation of agricultural land to ensure its conversion into forests, meadows and steppe;
- vulnerability to climate change (violent temperature swings, fires, flooding, droughts and other natural disasters) and land degradation;
- damage to forests by pests and diseases;
- biodiversity loss;
- the slow rate of expansion of natural reserve areas.

2.7.5 POLICIES AND MEASURES

To achieve the nationwide NDC target, specific policies and measures have been drawn up and are already being implemented:

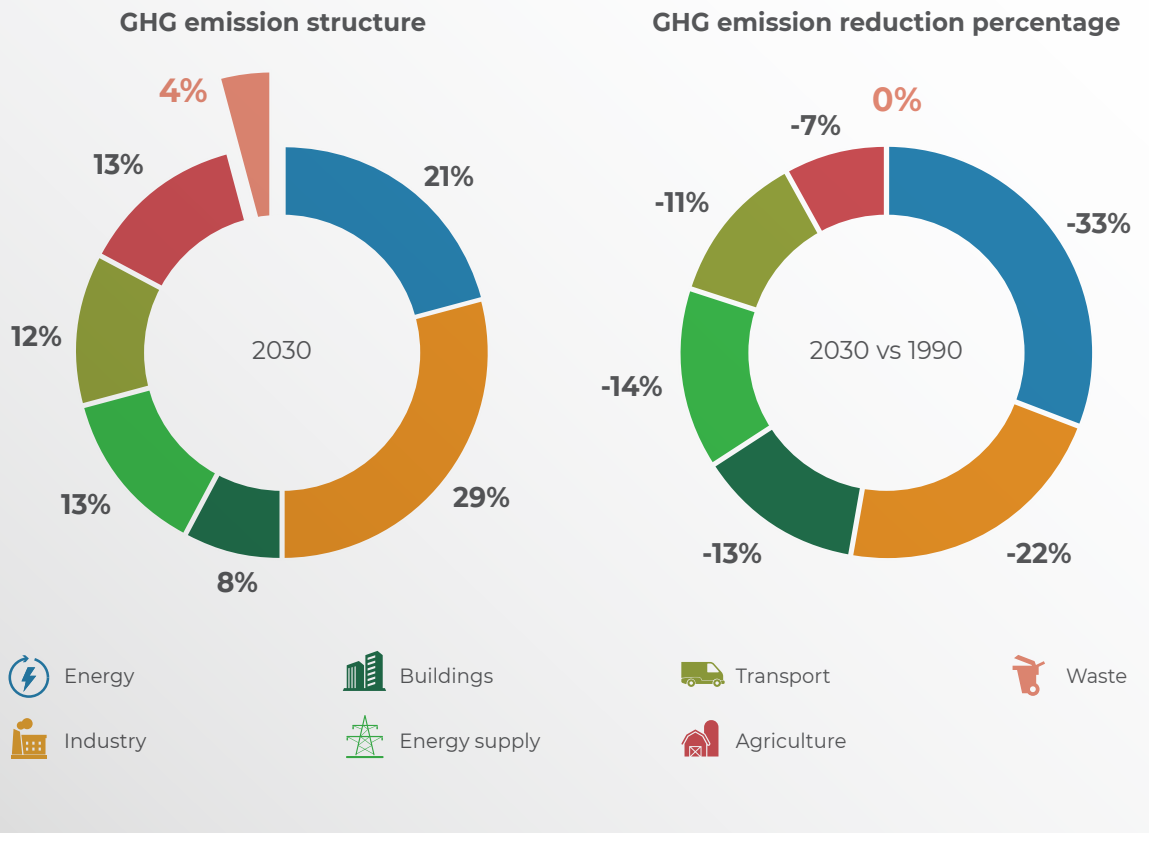
- increase in the area and legislative regulation of territories granted Emerald Network status;
- preservation of natural forests on agricultural lands and their transfer to the forest fund, incentives for the creation of private and municipal property on these lands;
- identification of forestlands not provided for use, and providing them for permanent use to forestry enterprises of state and communal forms of ownership;
- afforestation of degraded lands of low fertility that are not used for agricultural purposes (with consideration for the type of natural environment and avoiding the afforestation of environmentally significant areas of grasslands and meadows);
- new modern approaches to fire management and ensuring sustainable financing of fire countering and prevention measures (forest fund and natural ecosystems);
- a gradual transition to eco-friendly forest management techniques, with selective felling/extraction;
- reduction of peat extraction volumes and restoration of drained and degraded peatlands and wetlands.

2.8 WASTE SECTOR

GHG emissions in the waste sector were 12.2 million tons of CO_{2eq}. in 2018, which was 2% more compared to 1990, and 1% more compared to 2017. The key GHG source in the sector is methane generated by waste landfills and the process of sewage treatment. NDC envisages that GHG emissions in this sector will be cut to 11.6 million tons of CO_{2eq} in 2030 (-5% compared to the level of 2018, and - 2.5% compared to level of 1990. EUR 2 billion will be required to cover the costs of achieving this target in 2021-2030.

2.8.1 WHAT ARE THE KEY TRANSORMATIONS IN THE WASTE SECTOR?

Emissions



Methane emissions generated at solid waste burial sites have increased by 30.5% compared to 1990 due to annual growth in the volume of produced waste and the predominant practice of waste burial.

The relatively high cost of cutting GHG emissions generated in the process of solid waste treatment – EUR 200 per tCO_{2eq} – is due to two key factors: first, the need to introduce a new waste management system; second, the fact that concomitant reductions in GHG emissions from the use of waste as an energy source and material resource in industry, energy and agriculture are taken into account in these sectors

The implementation of the adopted Ukrainian Waste Management Strategy 2030 and the successful achievement of the goals it sets will allow a total cut in GHG emissions of 15.4 million tons CO_{2eq} over 10 years.

2.8.2 WHAT ARE THE BENEFITS FOR UKRAINE?

In addition to reducing GHG emissions and increasing the amount of waste recycling, Ukraine will be able to create a modern waste management system that will encourage people to be responsible consumers, and to reduce waste generation, and for producers to produce environmentally friendly packaging and goods, reducing waste in landfills and increasing its reuse and recycling.

In addition, the establishment of an effective waste management system will partially replace the use of fossil fuels for energy purposes, and stimulate landfill operators to implement efficient degassing systems, with the further production of energy from landfill gas. Separately, the reform of the sewerage sector will promote the introduction of a system of methane recovery from wastewater treatment and a system of denitrification of sewage sludge.

Considering that about 80% of total GHG emissions is generated in the raw material production phase, one of promising steps to promote GHG emission reduction consists of re-use of industrial waste, particularly metallurgical slags as well as ash and slag materials for construction of cement concrete roads.

2.8.3 WHAT WILL BE THE COST FOR UKRAINE?

This sector requires EUR 2 billion in investment. The average cost of cutting GHG emissions in the sector is EUR 120 per ton of CO_{2eq}.

To achieve the NDC nationwide target and promote further substantial GHG emissions reductions, additional regulatory and economic mechanisms are required:

- credit programmes for the development of the relevant infrastructure (for waste management, sorting and recycling; sewage treatment);
- incentivize the use of landfill gas as energy resource;
- incentivize methane capture (from sewage treatment);
- incentivize the organic waste composting;
- increase waste burial taxes;
- introduce the principles and mechanisms of the circular economy.

Regulatory mechanisms:

- adopt framework legislation on waste management, fully in line with EU standards;
- adopt sectoral draft laws regulating the management of different waste types (packaging, electric devices, batteries etc);
- formulate policies and encourage development of the circular economy (creating transparent and competitive secondary raw material markets through of improving and harmonizing Ukraine's legislation with the relevant EU legislation, rules and regulations; incentivizing minimization of waste generation; simplifying the procedure of scrap metal transactions; introducing the extended producer responsibility system; implementing a package of measures for commercialization of industrial waste discharges);
- limit the use of single-use plastic;
- create an effective waste treatment system, and build necessary infrastructure based on cooperation of territorial communities;
- ensure the placement of waste extraction sites exclusively in accordance with regional waste management plans;
- incentivize development of alternative fuels derived from solid domestic waste and industrial waste in the cement industry.

2.8.4 SECTORAL CHALLENGES

- Low waste burial/management tariffs;
- lack of incentives to recycle solid waste;
- need to update the relevant regulatory framework.

3. ADAPTATION

2020 was a record-breaking year for Ukraine in terms of the negative impact of climate change. Damage caused by forest fires and floods alone exceeded UAH 26 bn. In 2020, a total of 2,594 forest fires were recorded by the State Forestry Agency, affecting a total area of 74,600 hectares. Compared to 2019 the number of fires doubled, while the area affected was 72-times greater. Financial losses were over UAH 19.11 billion according to the State Forest Agency.

At the same time, according to the State Emergency Service, excessive summer precipitation resulted in extreme weather phenomena inflicting damage of UAH 6.7 billion. Thus, as a result of flooding in Zakarpattia, Ivano-Frankivsk, Chernivtsi, Lviv and Ternopil regions, 263 settlements suffered damage and destruction.

In addition, a lack of moisture in the soil caused the death of winter crops on an area of more than 400,000 hectares during 2020, and across an even larger area yields dropped significantly, which caused 80-100% in crop losses to agricultural producers, and the value of exports of agricultural products to fall by UAH 3.5 billion. In view of the amount of precipitation during the winter of 2020/2021 and moisture content, it is expected that grain crop yield will grow by 14.6% in 2021. However, this sector is extremely dependent on climate change, hence adaptation to climate change has a substantial potential.

The most noticeable consequences of climate change are not only a gradual rise in temperature, but also dangerous weather phenomena such as severe droughts, floods, storms, hurricanes, and heat waves, the frequency and intensity of which are increasing. Ukraine has already faced water supply problems and the degradation of agricultural land and forests.

Ukraine, according to experts, by the end of the 21st century is expected to see an increase in droughts, and an expansion of the arid zone from the south to the entire central region, along with a redistribution of precipitation patterns.

An important component of Ukraine's integrated climate policy is the development of the 2030 Climate Change Adaptation Strategy. The goal of the Strategy is to mitigate climate change for higher environmental security in Ukraine.

Key objectives of the Strategy are as follows:

- supporting environment-related Sustainable Development Goals;
- reducing industrial pollution;
- ensuring sustainable use of natural resources;
- achieving "good conditions" of water and marine resources;
- ensuring sustainable forest exploitation and improvement of forestry economic indicators;
- creating legal and financial grounds for the introduction of a waste management hierarchy;
- raising effectiveness of the state system for environmental impact assessment and control of environmental impact of economic activities;
- preserving biodiversity and ensuring development of the nature reserve fund in Ukraine;
- strengthening adaptation capacity and resilience of social, economic and environmental systems to climate change;
- promoting the development and inclusion of measures concerning environmental safety and adaptation to climate change in national, regional, local and sectoral policies, strategies, river basin management plans, and action plans;
- improving the education and outreach system, raising awareness of decision-makers, building human and institutional capacity for climate change mitigation, adaptation, impact reduction, and early warning.

The main cross-sectoral tasks for adaptation to climate change:

- conducting regular sectoral research into risk assessments and vulnerabilities, and climate change forecasting at the national and regional levels;
- drafting regular reviews and reports on observations of climate change and its predicted consequences;
- drafting action plans for the Climate Change Adaptation Strategy's implementation;
- integrating climate change adaptation into laws regulating the interaction of central authorities with regional governments, and Kyiv and Sevastopol city state administrations, with regard to environmental protection;
- the technical modernization and development of hydrometeorological observation systems;
- introducing climate change awareness-raising measures for the population, business and central executive power bodies, local authorities, and local self-government bodies;
- the inclusion of climate change issues in educational and postgraduate training programs;
- the identification of prioritized adaptation measures for further implementation at the national and local levels;
- preparation of recommendations for the formation of action plans on sustainable energy development and climate change for cities and united territorial communities.

The strategy will be implemented with the use of following tools – systemic and regular vulnerability and risk assessments for selected sectors, and drafting and implementing sectoral action plans on climate change adaptation. It is expected that after the implementation of all of the relevant measures, Ukrainian society will enhance its resilience and become fully adapted to climate change outcomes.

4. INVESTMENT VOLUME AND FINANCIAL SUPPORT

Ukraine's transition to a climate-neutral economy will require around EUR 102 billion in capital investment by 2030. This amount reflects the cost of implementing the NDC scenario in general, but breakdowns of the costs for industry, transport and the energy supply sectors will also be required.

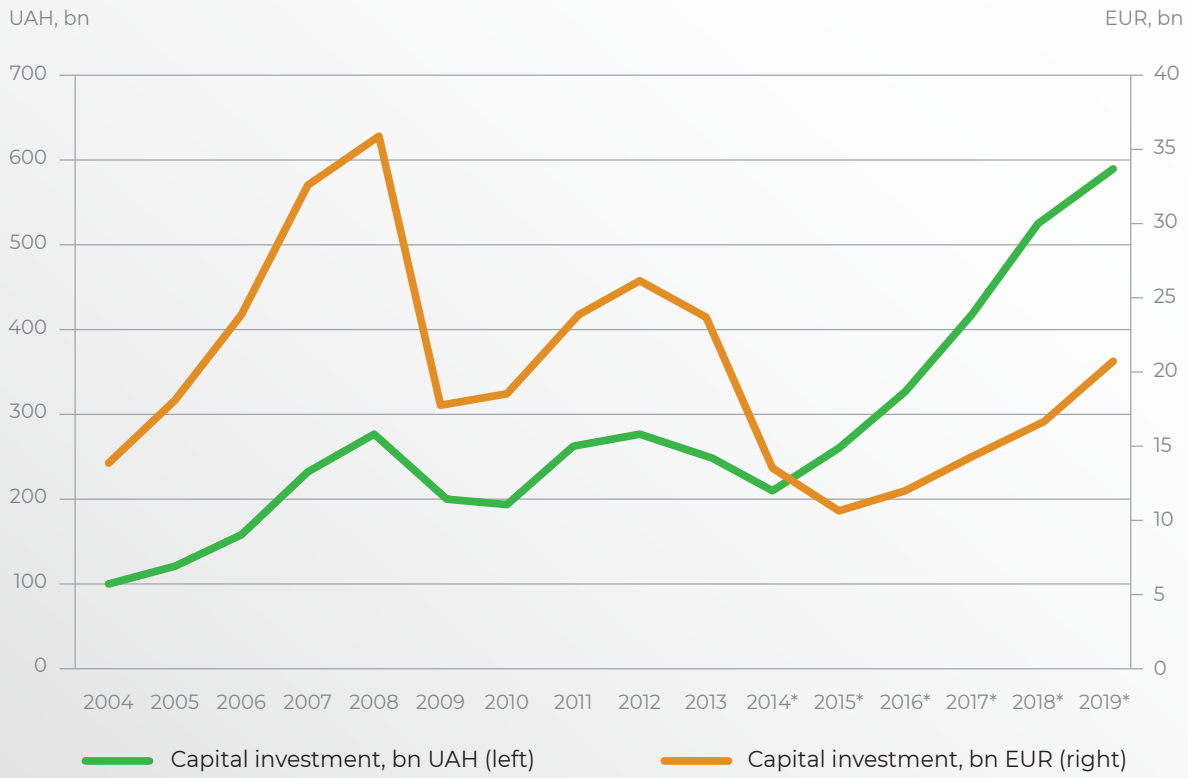
Having determined the GHG emission targets in NDC for industry, transport and the energy supply sectors, we adjusted the goals for GHG emissions and necessary policies and measures downwards. Currently, a lack of technical capacity and time prevent us from recalculating the amount of investment at this stage, and further clarification is required in future. For the industrial sector, we took into account the calculations obtained on the basis of modelling results (Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine), which represent the maximum required investments. A major part (EUR 20 billion) of the preliminary calculated investment needs amounting to EUR 26 billion is required for new generating capacities for renewable energy sources (RES) in the energy sector. Considering that the target in this sector was adjusted with the RES share ambition reduced, the amount of investments required will also decrease, but this needs detailed additional calculations. The volume of investment in the transport sector includes only the state subsidies or tax exemptions needed to achieve a 3% share of private electric vehicles in 2030. Estimates regarding investments in public, rail and water transport require additional calculations, but will result in an additional GHG emission reduction compared to that proposed for the transport sector in NDC. Investment in the building sector was adjusted according to the reduced ambition concerning building thermal modernization rates, and the population's consumption expenditure for purchase of goods was excluded. In the agriculture sector, according to the adjusted ambition concerning the GHG emission level and necessary measures, the volume of necessary investment was adjusted to make EUR 2.3 billion. These calculations, however, do not include the cost of withdrawal of 1 million hectares of degraded land for restoration of ecosystems and afforestation, and will not require additional calculations.

Table 1: Investments required to achieve the NDC target in 2021-2030
(*sectors will require additional calculations due to adjusted GHG emission ambition)

Sector	Capital investment, EUR bn
Total	**102**
1+2. Energy + Industrial resources (without consumption expenditures)	**93**
Agriculture	**2**
Production of energy and heat	**26***
Industry	**37***
Buildings * (without consumption expenditures)	**16**
Heating	*16*
incl. modernization of buildings	*13*
Energy resources extraction and transportation	**8**
Transport (without consumption expenditures)	**3***
Private vehicles	*3*
3. Agriculture	**2.34**
4. LULUCF	**3**
5. Waste	**2**

We expect that average annual capital investment in 2021-2030 will reach EUR 10 billion. In 2019 this amount reached approximately EUR 20 billion (50% of 2019's level).

Capital investments in Ukraine 2014-2019



* without data from temporarily occupied territories of Donetsk and Luhansk regions, the Autonomous Republic of Crimea and Sevastopol city

NDC funding must include a combination of domestic budget allocations, private sector (domestic and foreign) bilateral and multilateral financial mechanisms, and development support.

According to the State Statistics Service, in 2010-2019 capital investment in Ukraine was mobilized via:

- State expenditures:
  - State budgets (4%)
  - Local budgets (5%)
  - Public housing funds (8%)
- Private expenses:
  - Enterprises' and organizations' own funds (66%)
  - Bank and other loans (11%)
  - Funds of foreign investors (2%)
- other sources of funding (3%).

These funds are mostly provided by private investors, who are typically more skilful in the management of risks related to the construction and operation of facilities. Thus, the role of the public sector is rather to focus on providing the necessary regulatory instruments, financial incentives and information exchanges to attract investment from the private sector.

However, both state and local budgets play an important role in boosting capital investment in the various sectors presented in NDC.

In developed countries, private sector funding provides two-thirds of the resources for low-carbon infrastructure development. Public sector resources comprise the remaining third, via low-interest loans from state-owned development banks or special support programmes.

4.1 BUDGET INVESTMENT

The most important goal in developing a climate finance strategy for Ukraine is to ensure the efficient use of public funds and the mobilization of private financial investment. As state and local budgets are limited, support for Development Finance Institutions (DFIs) and other sources of co-financing is needed to further mitigate climate change, and for adaptation. The following is a brief overview (i) of public and local finances in Ukraine; (ii) bilateral and multilateral financial institutions; (iii) climate funds and (iv) fiscal and climate policies.

State and local budget

State and local budgets should play an important stimulating role in increasing capital investment in the various sectors of the economy described in this report. The main task is to create a favourable investment climate for the implementation of a "green" energy transition, encouraging businesses and private investors to invest in environmentally friendly technologies and infrastructure. One solution may be to extend tax incentives to encourage green investment (for example, exemptions for electric vehicles from VAT on sales, and from excise duties.

Ukraine already has experience in channelling state and local funds through grants or subsidies that have successfully attracted private investment. In addition, there are public-private partnership (PPP) programmes, interregional cooperation, “warm loans”, and in the long-run, green bond instruments. In the framework of interregional cooperation from 2015 to 2020, more than 100 agreements related to environmental improvements were signed.

The positive experience of implementing PPP programmes and cooperating with Financial Development Institutions (DFIs) provides opportunities for the further effective state funding for climate mitigation measures.

National funds

When implementing NDC, Ukraine could make use of existing state funds, or create new ones. A special state fund could finance climate projects from various sources, as well as facilitate coordination and support for transformation in particular sectors via special programmes. For instance, in the EU there is the Modernization Fund, and in Poland the National Fund for Environmental Protection and Water Management. These are separate financial institutions that provide financing in accordance with adopted programmes and criteria, and on the basis of various support mechanisms – loan coverage, co-financing, grant programmes, etc.

Development Finance Institutions (DFI)

DFIs have long been an important source of sustainable investment in Ukraine, which is ranked 4th among global recipients of climate financing from such bilateral and multilateral sources. In total, the EBRD and EIB mobilized over EUR 13 billion in loans and EUR 2 billion in grants from 2014 to 2019 to stabilize the Ukrainian economy and implement comprehensive economic reforms. DFI is expected to continue to act as a catalyst for attracting sustainable investment in Ukraine.

The EIB mobilized EUR 4.6 billion in loans to support infrastructure development and reforms in the transport, energy, agriculture, education and municipal sectors. The EBRD has also invested EUR 4 billion to promote the development and reform of the banking sector, agrobusiness, the transport sector, and small business. In addition, the EU Annual Action Programme, funded from the EU framework budget, attracted EUR 165 million in several budget areas (agriculture and small farm development; technical cooperation; civil society; and climate action).

If one third of Ukraine's future funding (2021 – 2030) provided by the EU were to be allocated to climate change prevention projects, about EUR 10 billion could be raised (equivalent to EUR 1 billion per year).

Today, the most significant contributors to climate financing are the World Bank Clean Technology Fund (CTF);the Global Environment Facility (GEF), operating in Ukraine via UNDP, UNEP and UNIDO; the Finland-Ukraine Trust Fund, established by NEFCO; and the Eastern European Partnership on Energy Efficiency and the Environment (E5P), established for activities in Ukraine by the European Commission.

Fiscal and climate policy

To ensure the implementation of required sectoral transformations, it is necessary to reform environmental financing and ensure the targeted use of GHG emissions tax. In the context of revenues, this may include increasing the GHG tax rate and base, introducing a GHG emissions trading system and permit auctions, and the establishment of market mechanisms to strengthen the climate for green investments.

In addition to ensuring the market clarity, the government must improve the legislative regulation of the issuing of green bonds, ensuring that they are used to implement environmental projects.

5. GENDER ISSUES AND WAYS OF TACKLING THEM

According to the Law of Ukraine “On Ensuring Equal Rights and Opportunities of Women and Men”, responsibility for ensuring gender equality is placed on authorities of all levels. At the level of the central executive authorities, responsibility for coordination of the gender policy implementation is placed on the Ministry of Social Policy and the Cabinet of Ministers of Ukraine. However, despite a developed institutional mechanism to ensure gender equality, a gender approach has not been integrated into the climate policy so far.

Cross-sectoral gender issues within the NDC reflect the gender issues present in Ukrainian society. Women are underrepresented in climate policy decision-making, a gender pay gap exists in all the sectors involved in counteraction of climate change, and the share of formally employed women is lower than that of men, particularly among entrepreneurs in areas concerned. Vulnerable groups of women and men have less resources to adapt to climate change consequences. For example, according to research, heat waves affect vulnerable populations most of all, including older persons, the majority of whom are women. The need to adapt to climate change is more typical for persons working in open air and spending more time in public places (e.g. child-carers, most of which are women).

Besides, there are sector-specific gender issues. For example, increase of utility service tariffs is likely to result in higher prevalence of energy poverty in Ukraine that will affect first of all vulnerable populations including women. To pay for the utility tariffs, the poorest population segments will have to save on other needs such as food, education and health care, which will result in lower quality of life and health problems.

Ways of tackling the existing gender issues

The first requisite step towards tackling gender issues consists of collection data disaggregated by sex and other attributes. The data will help identify gender gaps and develop approaches to overcoming them, including with the aid of positive measures. Besides, it is important to gather relevant data about recipients of financial and other support within climate change counteraction programmes. Furthermore, the implementation of positive measures to involve women in sectoral development will promote fairer resource distribution and sustainable development of sectors.

Taking measures to appoint women to executive and technical positions at sectoral enterprises is another important step to overcome gender issues. Such practices promote not only elimination of gender gaps but also enhancement of operating effectiveness and sustainability of enterprises concerned. Implementation climate change adaptation measures (adaptation of public transport to higher temperatures, creating green spaces in cities, etc.) will also help achieve gender and climate equity because women and other vulnerable population groups are the most vulnerable to climate change consequences.

Besides, when formulating and implementing a climate policy, consideration of gender aspects (specific characteristics of living conditions and needs of women and men) is important. For example, women use energy resources mainly for cooking, water heating, cleaning and other domestic and care work, hence they are more dependent on energy resources and more informed about their use. Therefore, taking these aspects into account can provide a more effective solution to the information problem (unawareness of the quantity of energy consumed and its possible reduction using energy efficiency measures) and highlight the need to consult women when implementing changes in individual heat supply systems at the household level.

In addition, creation of auxiliary mechanisms to ensure gender equality will also foster systematic gender mainstreaming of the climate policy. No less important is development of partnerships with CEA-level institutions and officials responsible for implementation of the gender policy as well as with civil society organizations dealing with gender equality and climate change.