

OLEG SAVITSKY

# Towards the end of the coal age in Ukraine?!

A review of the Ukrainian coal sector in the context of the Donbass crisis



## About the Author

Oleg Savitsky is a climate and energy campaigner at National Ecological Centre of Ukraine, an environmental advocacy organization based in Kyiv.



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## Towards the end of the coal age in Ukraine?

A review of the Ukrainian coal sector in the context of Donbass crisis  
by Oleg Savitsky

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Editors: Robert Sperfeld and BethAnne Freund

Design: Olga Vashchevska

Cover photo and illustrations: Vladimir Lapshyn

<http://photographers.ua/VladimirLapshin/profile/>

This publication can be ordered from: Heinrich Böll Foundation office in Ukraine, Volodymyrska st., 18/2, office 3, 01001 Kyiv

**T** +38 044 279 98 58

**F** +38 (044) 270 52 78

**E** [ua-info@ua.boell.org](mailto:ua-info@ua.boell.org)

**W** [www.ua.boell.org](http://www.ua.boell.org)



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Photo by Oleg Savitsky

## **PREFACE**

The turmoil in the Ukrainian coal industry as a consequence of Russia's military aggression against Ukraine remains somewhat out of the focus in the debate on energy policy, though the conflict significantly changed everything. Everyone is talking about gas because the potential for political blackmailing from the Russian side was much higher in this sector, but this is not the only reason why the Heinrich Böll Foundation's Kiev office asked the National Ecological Centre of Ukraine (NECU) to compile this analysis on the coal sector. Ukraine still ranks among the top twenty emitters of greenhouse gases in the world. The coal sector contributes most to this dubious honor. Prior to the 2015 climate conference in Paris, we would like to shed some more light on what is going on with coal in the very specific current political and economic context of Ukraine.

Above all, this paper is intended as a comprehensive analysis of the country's coal sector based on existing data. It is beyond the scope of this research to develop reliable scenarios and timelines for the future role of coal in the Ukrainian energy mix. However, we aim to bring up a painful subject, to raise questions and to bring political attention to these issues.

Globally, coal's stars are fading. The fuel source is one of the biggest challenges for climate change. If governments worldwide are serious about the goal of keeping global warming below 2°, there will be a price tag for CO<sub>2</sub> sooner or later. International investors are beginning to hesitate before investing in coal. Local populations are suffering from air pollution and dangerous work conditions in mines that devastate the environment and already scarce water resources. China's coal industry has reached its tipping point – in 2014, coal consumption there decreased for the first time. Meanwhile, much more is being invested into renewables, which are becoming more and more economically reasonable even without subsidies.

Against this background, Ukraine should define the future of its coal sector very carefully. Much more research is needed to propose a realistic transition path to a future of sustainable energy for the country. However, there is a lot indicating that this future can be based on decentralized generation from various renewable sources, comple-

mented in the short term by gas-based capacities that can be efficiently used to balance fluctuating renewables. Thus, dependency on expensive imported coal and nuclear fuel can be avoided and energy security can be increased. Other countries can serve as examples of how a transition based on efficiency and renewables can create jobs and innovation for the domestic economy.

Many thanks to Oleg Savitsky, campaigner for climate and energy policy at NECU, for extensive research work on this topic – may it encourage many more complementary analyses.

Kiev, July 2015

Robert Sperfeld, Acting Director Heinrich Böll Foundation Kiev Office

## **EXECUTIVE SUMMARY**

This analytical paper compiles information on the current state of the Ukrainian coal sector in light of the military conflict in eastern Ukraine and in the context of ongoing energy sector reform.

In 2013, with a share of 35.8% in the energy mix, coal was Ukraine's most important primary energy source, followed by natural gas with 34.1% and nuclear with 18.9%. Coal in Ukraine was mainly used for power generation, the metallurgical industry and heating utilities. Total consumption, according to different statistics, was between 61 and 74 million tons (2012). Net imports amounted to around nine million tons.

### **Reserves and Mining**

Ukraine accounts for 3% of the world's total coal reserves. Ukraine's coal deposits are concentrated in the Donets and Lviv-Volyn hard coal basins and the Dnieper brown coal basin. Most of Ukraine's hard coal deposits (up to 95%) are located in Donets Basin (Donbass), which spreads over the regions of Donetsk, Lugansk and Dnipropetrovsk. Brown coal is exploited only on a very small scale, mostly for briquette exports. In western Ukrainian Lviv-Volyn basin, two million tons of relatively low quality coal is mined annually in 13 operational state-owned mines. In Donbass, around 65 million tons of coal was extracted from an average depth of 700 meters in 2012. Some mines operate at depths of up to 1,400 meters, and coal seams are relatively thin (1 to 1.2 meters). On average, mines have already been in operation for 45 years.

Because of the war in eastern Ukraine, of the 82 mines in the Donbass region only 23 remain in territories controlled by Ukrainian authorities. All anthracite mines are located in areas controlled by separatists. Many mines either suffered direct damage from shelling or were flooded as a result of the interruption in electricity supply. Restoration of former production levels seems impossible. Coal extraction in Ukraine declined by 60%, and the need for imports and thus dependency on foreign supply increased significantly. In particular, there is a shortage of anthracite coal, which cannot be easily replaced by different types of coal.

Even before the military escalation of the conflict in the east, around 10% of Ukrainian coal was estimated to be produced in industrialized illegal mines that were part of large-scale corruption schemes organized in the Yanukovych era.

## **Electricity and heat sector**

Power generation from coal and gas is managed by five generation utilities that operate 14 large-scale thermal power plants (TPPs). Only three of them (one utility company) are owned by the state, while nine belong directly to Rinat Akhmetov's company DTEK and the remaining two are controlled by a businessman close to Akhmetov.

Total installed coal-fired power generation capacity is 21.9 GW (compared to around 5 GW of installed natural gas capacity in TPPs and 13.8 GW of nuclear capacity). The average load factor is only 35%. A large share of the capacity is used only in peak demand situations, which is very inefficient. The technical equipment in most of the units is extremely old, and emission levels are very high.

Similarly, the grid infrastructure is very old and inefficient. Losses in transmission and distribution amount to more than 12% of total supply, twice as much as in Poland.

Around 30% of Ukrainian heat generation is coal based, though the share is lower in western Ukraine and higher in the east of the country. Utilities are mainly government owned, though privatization is being planned.

## **Climate and environment**

Ukraine remains among the top 20 CO<sub>2</sub> emitters and is one of the most carbon-intensive economies in the world. Emissions per GDP unit are two times higher than in Poland and more than three times higher than in Turkey. At the same time, the carbon footprint of an average Ukrainian is smaller than those in coal-extracting countries in the EU – carbon dioxide emissions per capita in Ukraine amount to 6.3 tons of CO<sub>2</sub>e, while Germany's and Poland's come to 8.9 and 8.3 tons of CO<sub>2</sub>e per capita, respectively.<sup>1</sup> The coal sector accounts for half of Ukraine's greenhouse gas emissions (2013).

Environmental management and enforcement of environmental law are very poor throughout the sector. The coal industry is responsible for 80% of total sulfur dioxide emissions in Ukraine and 25% of nitrogen oxide emissions. Levels of hazardous emissions at Ukrainian TPPs exceed the EU standards by 5 to 30-fold and often exceed national emission restrictions. At many TPPs, dust emissions are up to 45 times higher than EU emission limits. Purification of sulfur and nitrogen oxide from flue gases is practically absent at Ukrainian TPPs.<sup>2</sup> Particularly alarming is the environmental situation around many illegal mine sites. The consequences of the flooding of several mines caused by the military conflict are currently unpredictable.

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<sup>1</sup> According to World Bank data

<sup>2</sup> Bankwatch: "Dusting off Ukraine's energy sector: Why the country must address inefficiency and pollution at its ageing coal-fired power plants" <http://bankwatch.org/publications/dusting-ukraines-energy-sector-why-country-must-address-inefficiency-and-pollution-its->



## **Social and health aspects**

The estimated number of jobs in coal mining, processing and thermal power utilities is 450,000 (2013). Relative to output, this number is very large – twice as high as in Poland, for example. Because of extremely old equipment and low industrial safety standards, work conditions are very bad, and accident rates are extremely high. In 2014 alone, 99 workers died. Air pollution from TPPs and the steel and chemical industries is a serious risk for public health in the affected regions, with 22,000 deaths attributed to this air pollution annually.

## **National economy and governance**

Ukraine has experienced a far-reaching energy policy takeover by private business interests in collaboration with corrupt networks in the government. After Viktor Yanukovich took office in 2010, the most important parts of the Ukrainian coal sector were privatized and monopolized by Rinat Akhmetov's business group. The sector is an enormous economic burden for the country. Direct subsidies to mines in 2012 amounted to 1.3 billion euros (3.8% of the state budget). Ukraine's membership in the European Energy Community (EEC) since 2010 and the resulting policy requirements seem to have had no impact whatsoever on counteracting these developments. The ratio of primary energy supply per GDP unit – the energy intensity – is higher than the IEA average by a factor of 2.76 (2012). For today's reform agenda, the requirements of the EEC membership constitute a helpful referential policy framework facilitating necessary restructuring in the energy sector. During the recent crisis, governmental coal policy was limited mainly to ad hoc crisis interventions to ensure supply stability. Current drafts of the Energy Strategy until 2025, however, do not envisage significant decreases in coal-fired capacities.

## **Conclusions**

In the course of the conflict in eastern Ukraine, the country has lost control over the heartlands of coal in Ukraine. Even if the Ukrainian government takes back power in the region soon, there are no reasons to keep alive or restore coal mining to the way it had operated previously. Even before the beginning of the crisis, mines were able to survive only thanks to huge direct subsidies and with devastating external costs for the environment and for the health of workers and local populations. What is more, a reformed energy sector in the country will not need coal anymore in the longer term. The potential for improving energy efficiency in the electricity and heat sectors and in industry is huge. Thus, the overall energy consumption levels will decrease. Further use of coal would increase the dependency of the country on imports. In terms of technology, a large number of coal mines and coal-fired power plants are extremely old and inefficient, with high emissions levels and poor industrial safety conditions. Significant modernization investments are not economically viable at all. In addition, the electricity system above all needs flexible reserve capacities to cover peak load situations and to balance fluctuating generation from wind and solar – coal-fired TPPs can fulfill this task only with a very low efficiency. Existing gas-based reserve capacities can do this job much better.

What is to be done? It is well beyond the scope of this paper to offer an action plan addressing all related aspects. In the given framework of Ukraine's membership in the EEC, the energy sector needs a fundamental reorganization based on the principles of transparency,

de-centrality and fair competition between private companies / service providers with the politically controlled policy objectives of sustainability, supply security and cost efficiency. A central element here would be the establishment of an independent regulatory authority for the energy markets.

More specifically with regard to the coal sector, the government needs to provide a status analysis of the remaining mines and coal-fired TPPs and develop a clear phase-out strategy, fitting into an overall strategy of a transition to a sustainable, low-carbon economy. Incentives should be put in place to shut down the most polluting sites first. Thus, investment security can be achieved for grid modernization, for installing filters at those TPPs that cannot be closed in the very near future, and for substitution investments into new (renewable) capacities.



# 1. Key energy indicators

## 1.1 Energy consumption

Primary energy consumption in Ukraine is nearly the same as in Poland, the Netherlands and Turkey. Meanwhile, the mentioned countries' GDP figures are several times higher than in Ukraine. For example, Poland's economy is almost twice as big, although its primary energy supplies are almost equal to those of Ukraine. This can be explained by systemic crises and disproportions in the Ukrainian economy and high levels of energy losses and low efficiency in both households and industry. The most critical situation has been observed in heating, electrical infrastructure and metallurgical and chemical plants.

At the moment, the Ukrainian economy is the most energy intensive in Europe, even less efficient than Russia's economy. In 2012, Ukraine's energy intensity, i.e. the ratio of total primary energy supply to gross domestic product in purchasing power parity terms, was 2.76 times the world average according to the IEA. Russia's was 2.69 times the IEA world average.

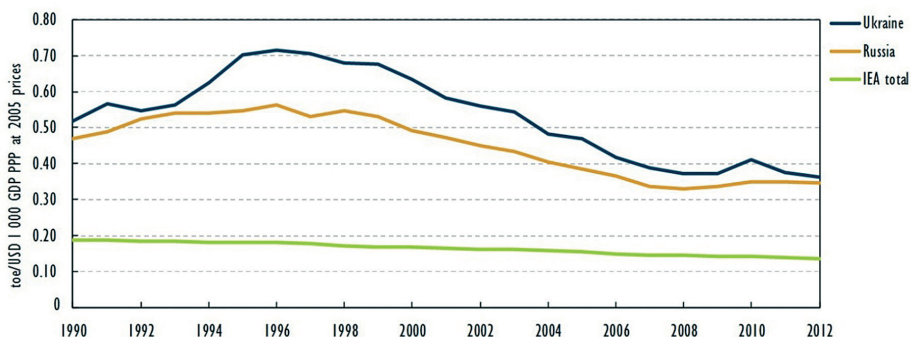


Figure 1: Energy intensity in Ukraine and Russia. Source: IEA (2014)

In 2013, more than half of the country's primary energy supply came from coal and nuclear power, although natural gas also played an important role in the energy mix. Petroleum and other liquid fuels accounted for only a relatively small share of the country's total energy consumption, while renewable energy sources accounted for less than 3%.

### PRIMARY ENERGY CONSUMPTION IN UKRAINE 2013, %

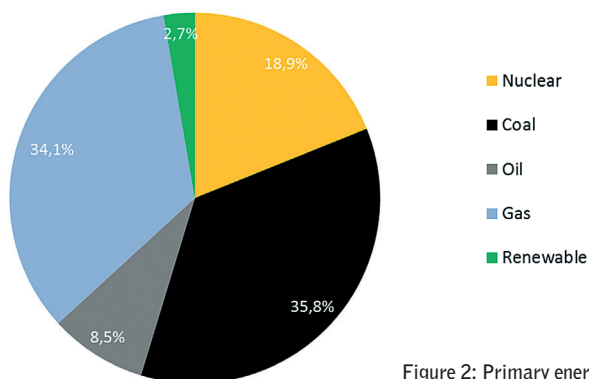


Figure 2: Primary energy consumption in Ukraine in 2013.  
Data source: State Statistical Service

Statistical information in the country lacks integrity and is not transparent, especially in the coal sector. Publicly available official data is often in conflict with other sources. According to Euracoal,<sup>1</sup> in 2012 coal consumption in Ukraine amounted to 74.3 million tons, of which 55.5 % was used to fuel power plants, while official statistics from the Ministry of Energy and Coal Industry for the same year give a figure of 61.2 million tons, with 52.7% consumed by power plants.<sup>2</sup> A number of factors complicate coal statistics in Ukraine. Some of them will be discussed in chapters 3 and 4.

### COAL CONSUMPTION IN UKRAINE 2012, MILLION TONS

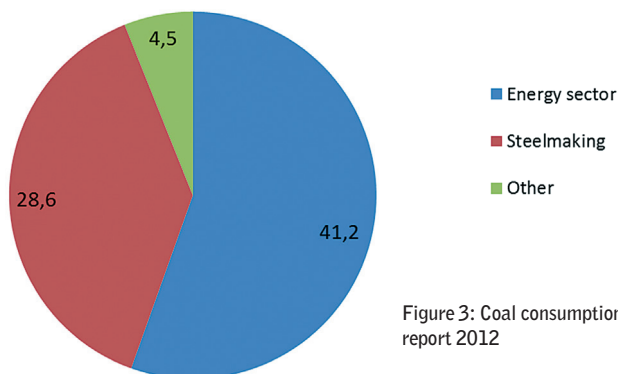


Figure 3: Coal consumption in 2012. Source: DTEK annual report 2012

1 <http://www.euracoal.be/pages/layout1sp.php?idpage=269>

2 Statistical information for 2012 [http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art\\_id=231058&-cat\\_id=35081](http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=231058&-cat_id=35081)

Traditionally, coal was one of the main energy sources in Ukraine, powering its massive metallurgical industry and one of the biggest fleets of thermal power plants in Europe. In 2013, it accounted for 36% of the country's total primary energy supply. But since 2014, the situation has changed dramatically after the escalation of military conflict in the Donbass region, where most of the coal had been produced. As a result of continuous fighting, the region's infrastructure was significantly damaged and numerous mines were flooded. In the fall of 2014, Ukraine saw a 60% decrease in coal production. Supplies of anthracite coal, which fueled half of the coal fleet, were completely interrupted. To cover the anthracite deficit, Ukraine started importing coal from South Africa and Russia, but in January 2015, Russia introduced a coal embargo and seized the supplies. The only remaining option is to ship anthracite from South Africa or other anthracite-producing countries (Australia or the US) through coal terminals with limited capacity located on the Black Sea.

In 2013, coal-fired thermal power plants (TPPs) provided 40.34% of the total electricity output. However, after the abrupt collapse of coal mining in the Donbass region and the consequent interruption of supplies, the share of coal in electricity generation has fallen significantly. TPPs, which were designed to run on anthracite, have seen severe fuel shortages since December 2014, and a significant number of them have ceased operation. In 2014, total electricity production from all sources of power generation decreased by 6%.

During the same period (since the fall of 2014), nuclear power plants slightly increased their power output and now play a major role in electricity generation. The share of renewables (mostly wind and solar) significantly increased in 2014, exceeding 1% of total electricity production for the first time (see Figure 4).

#### ELECTRICITY MIX UKRAINE 2014, %

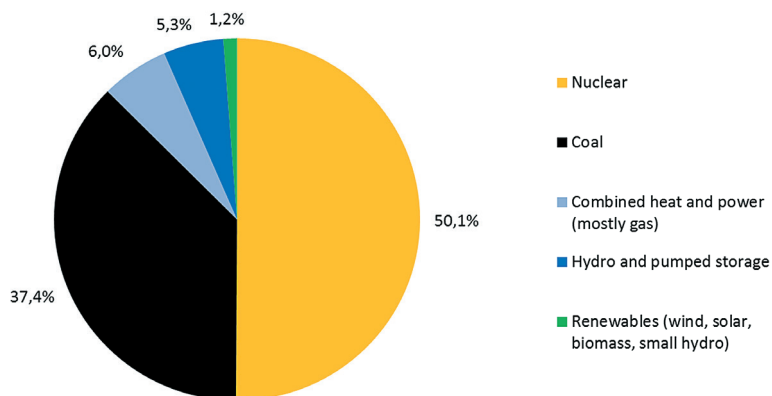


Figure 4: Electricity production in 2014. Data source: SE Energorynok

The Ukrainian electricity system is highly inefficient, and its grid infrastructure requires major renovation and decentralization to accommodate emerging renewable sources of electricity. Most of the grid infrastructure was built 40 to 50 years ago, and in the last 25 years, very little has been invested to modernize critical equipment (such as high-voltage transformers and switching gear), much less to optimize system performance.

**ELECTRICITY DISTRIBUTIONS LOSSES, BILLION KILOWATT-HOURS**

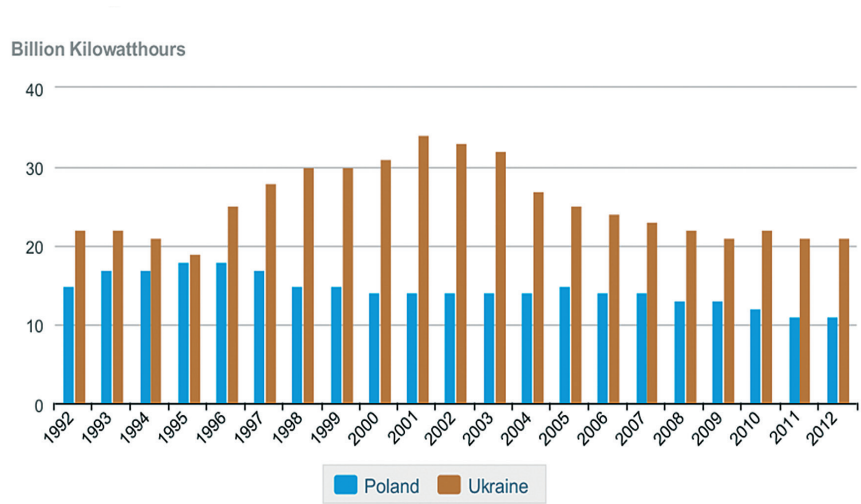


Figure 5: Electricity distribution losses in Ukraine and Poland.  
Source: U.S. Energy Information Administration

Electricity losses in transmission and distribution networks account for 2.42% and 10.17% of total supply, respectively. Distribution losses are nearly two times higher than in Poland. In 2013, distribution losses alone amounted to 20.7 TWh, or more than 50% of electricity consumption by Ukrainian households, which totaled 41 TWh that year and was the largest sector in terms of power consumption.

## ELECTRICITY CONSUMPTION BY SECTOR IN 2013, %

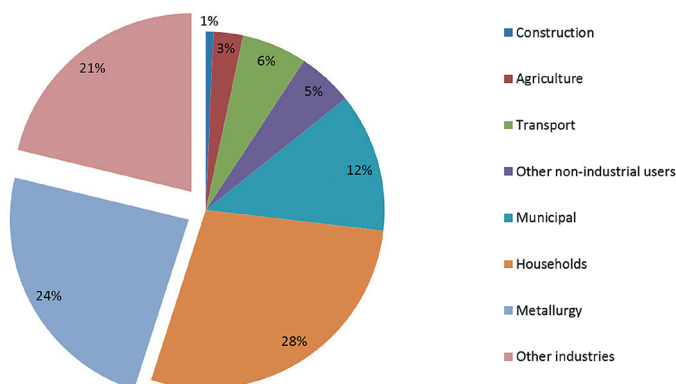


Figure 6: Electricity consumption by sector in Ukraine. Source: NGO Public Audit

In the same year, the second biggest consumer was metallurgy with 35 TWh or 53% of total industrial consumption.

## 1.2 Greenhouse gas emissions

Along with the entire region of Eastern Europe, Ukraine experienced a significant reduction in energy consumption during the 1990s because of an economic recession and the failure of many energy-intensive industries. At the same time, this resulted in a significant reduction in the country's greenhouse gas emissions. After the collapse of the USSR, Ukraine entered a deep socio-economic crisis with long-lasting negative implications. Some of them continue to shape the country even now, decades after the Soviet Union came to an end.

Unlike other Eastern European countries, which also used to be members of the Soviet bloc but which closed or refurbished their inefficient industrial processes and infrastructure, most of Ukraine's most energy intensive industries, such as chemical plants and steel mills, saw little to no improvement or re-structuring. The government also failed to address structural crises in the coal mining sector, resulting in its progressive deterioration.

Ukraine remains among the top 20 CO<sub>2</sub> emitters and is one of the most energy-intensive economies in the world. The carbon intensity of Ukraine's economy is twice as high as in Poland and more than three times as high as Turkey. At the same time, the carbon footprint of an average Ukrainian is smaller than those of citizens of coal-extracting countries in the EU – carbon dioxide emissions per capita in Ukraine amount to 6.3 tons of CO<sub>2</sub>e, while Germany's and Poland's come out to 8.9 and 8.3 tons CO<sub>2</sub>e per capita, respectively.<sup>3</sup>

Up until 2006, natural gas was used widely and freely for industrial processes and power generation, but since 2006, when Russia increased gas prices as a response to the

<sup>3</sup> According to World Bank data

**CO2 EMISSIONS IN UKRAINE, MILLION TONS**

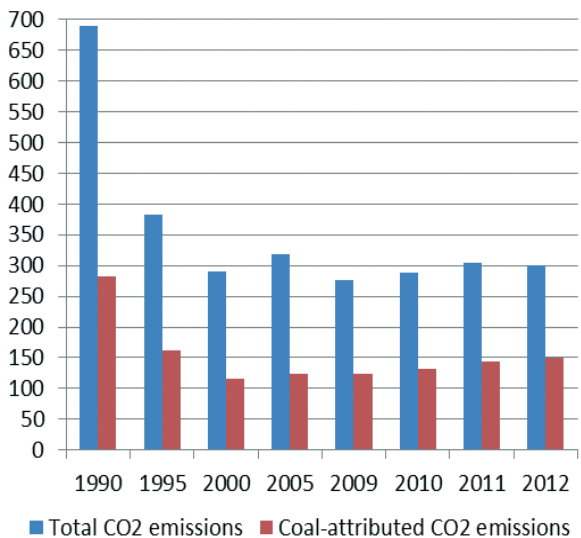


Figure 7: CO2 emissions, according to the National Emission Inventory for 2013 and IEA data

**CARBON DIOXIDE INTENSITY USING PURCHASING POWER PARITIES**

Metric Tons of Carbon Dioxide per Thousand Year 2005 U.S. Dollars

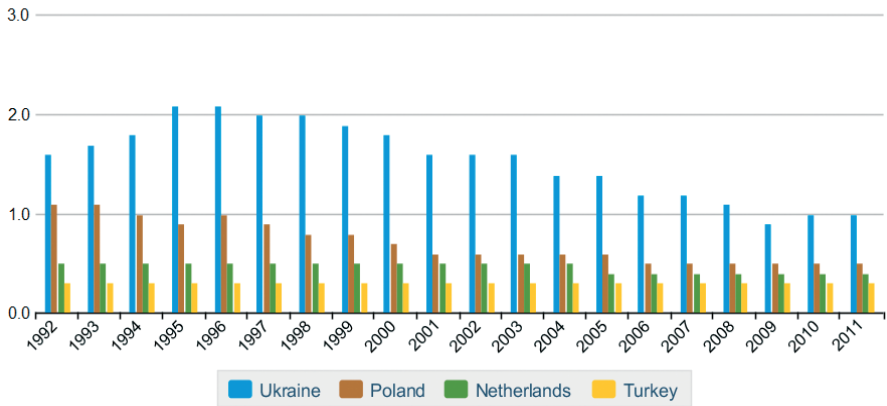


Figure 8: Carbon dioxide emissions per unit of GDP in Ukraine, Poland, the Netherlands and Turkey. Source: US Energy Information Administration

change in political course in Ukraine, consumption of gas has declined significantly and been substituted with coal. This change revived Ukraine's decrepit coal mining sector, and coal production has significantly increased. In 2010, the Yanukovych administration announced a number of initiatives to substitute natural gas with coal and greatly increase coal extraction. In 2012, with 85 million tons extracted (gross), coal was responsible for 49.7% of CO<sub>2</sub> emissions in Ukraine. Because of poor management in the energy sector, this resulted in an oversupply of coal in 2013. Other initiatives aimed at increasing coal extraction and consumption have also failed (see the case study of coal gasification technology in chapter 2).

## SHARE OF COAL IN CO<sub>2</sub> EMISSIONS

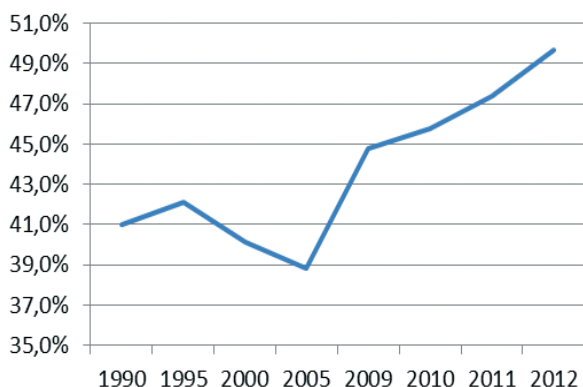


Figure 9: Share of coal in CO<sub>2</sub> emissions, National Emission Inventory for 2013

Besides CO<sub>2</sub>, Ukraine's energy sector is also responsible for considerably high methane emissions, most of which come from coal mining. Coal mine methane accounts for 80% of all methane emissions in Ukraine's energy sector and makes a significant contribution to the country's total emissions.<sup>4</sup>

Coal seams in Ukraine's deep mines have a high methane content, which is one of the causes of an increased accident rate. In most of the mines, coal bed methane is not being utilized and is simply vented to the atmosphere. According to research (Ardanova and Karol, 1993), coal mining was also one of the major sources of methane emissions in the Soviet Union.

<sup>4</sup> National inventories of anthropogenic emissions of greenhouse gases by sources and sinks in Ukraine for 1990-2011 <http://nci.org.ua/images/kadastr/2013/nir-2013.zip>, page 126

# 1.3 Energy imports and exports

Ukraine is highly dependent on imported energy, most critically on supplies of gas and nuclear fuel. In 2013, Ukraine imported 40% of its primary energy supply. That year, Russia dominated this arena with a near monopoly of 92% of the gas and 100% of the nuclear fuel supplied to Ukraine.

Expert estimates show that Ukraine’s economy has been spending up to 17 billion USD, or around 10% of its GDP, on energy imports each year. The country still remains critically dependant on fuel supplies from Russia. This fact, along with a high energy intensity and widespread corruption in the energy sector, poses a critical economical and geopolitical threat.

In terms of energy dependence, conflict in Donbass has weakened Ukraine’s position further. Even before the conflict, Ukraine was a net importer of coal because of high demand for quality coking coal for metallurgy. In 2012, Ukraine exported 6.1 million tons of hard coal (mostly thermal) and imported 14.8 million tons. The country’s dependence on imported coal dramatically increased in 2014 following a steep decline in coal production in Donbass and extensive damage to its mining and transport infrastructure. All anthracite mines are now situated in territories controlled by separatists. As a result, Ukraine became highly dependent on anthracite imports.

## COAL IMPORTS AND EXPORTS UKRAINE, THOUSANDS METRIC TONS

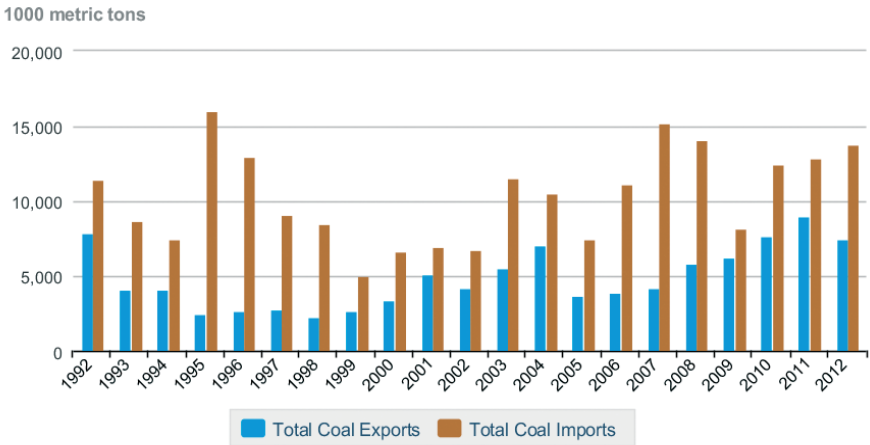


Figure 10: Coal exports and imports in Ukraine  
Source: US Energy Information Administration



During 2014, Ukraine's major private company DTEK continued exporting thermal coal at increased rates. This was interpreted by Mustafa Nayem, an investigative journalist and member of the post-revolutionary parliament, as a violation of national interests and as a threat to Ukraine's energy security on the part of DTEK's owner Rinat Akhmetov. In 2014, DTEK exported thermal coal (including anthracite) to Brazil, Mexico, Morocco and the UK.<sup>5</sup>

## 1.4 Amount and distribution of coal reserves

In 2012, Ukraine was ranked as the 14<sup>th</sup> largest coal-producing country in the world and 7<sup>th</sup> in recoverable coal reserves, which constituted 3% of the world's total. Ukraine's coal deposits are concentrated in the Donets and Lviv-Volyn hard coal basins and the Dnieper brown coal basin. Most of Ukraine's hard coal deposits (up to 95%) are located in Donets Basin (Donbass), which spreads through the regions of Donetsk, Lugansk and Dnipropetrovsk along the Siverskiy Donets River. Coal reserves in existing hard coal mines were estimated at 8.7 billion tons as of 2010. According to Euracoal, economically minable coal reserves amounted to 31.8 billion tons.

### MAP OF UKRAINE'S COAL DEPOSITS



Figure 11: Map of Ukraine's coal deposits Source: National Ecological Centre of Ukraine

<sup>5</sup> [blogs.pravda.com.ua/authors/nayem/546340e0a9955/](https://blogs.pravda.com.ua/authors/nayem/546340e0a9955/)

In Donbass, the average depth of the mines is 700 meters, and about 20% of the mines have depths between 1,000 and 1,400 meters. Moreover, coal seams are thin (85% of deposits are 1 to 1.2 meters thick) and tend to be very steep, which complicates the production process, worsens operating conditions, and increases the cost of production. Donbass provided 100% of coal production for metallurgy and around 97% of thermal coal production in Ukraine in 2012. That year, total coal extraction in the Donbass region was over 65 million tons.

The quality of Ukraine's coal is low and continues to worsen as a result of the depletion of coal seams. The ash content of coal produced for domestic needs is high and averages around 25 to 30%. Sulfur content specific grades of bituminous coal can reach 4%, with a minimum of 0.8% in anthracite coal from eastern Donbass.

In the Lviv-Volyn basin in 1980, there were 23 mines with a maximum annual output of 15.5 million tons of high-volatile bituminous coal. Currently only 13 are still operational; together, they provide up to two million tons per year.

According to official data, Ukraine has explored brown coal reserves of between six and eight gigatons with an average ash content of 20%. These deposits are located in the Dnipro basin, which covers a vast area along the Dnipro River.

In Soviet times, medium-scale extraction was active in two areas in central Ukraine, but lignite extraction has never played a significant role in Ukraine's energy sector. A 2007 decree from the Ministry of Coal Industry closed Ukraine's lignite mines and shut down the country's lignite sector.

Now, following a decrease in energy supplies from Russia and the collapse of hard coal mining in Donbass, lignite extraction is being discussed as a local energy solution for some regions of Ukraine.<sup>6</sup> Currently, Ukraine produces small volumes of lignite – less than 200 thousand tons each year – from the Olexandria and Mokra Kalyhirka deposits in the regions of Kirovohrad and Cherkasy. All extracted lignite is being briquetted and supplied for export.

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<sup>6</sup> [http://gazeta.dt.ua/energy\\_market/bure-vugillya-ne-panaceya-vid-energokrizi-a-efektivniy-energonosiy-dlya-deyakih-regioniv-ukrayini-\\_.html](http://gazeta.dt.ua/energy_market/bure-vugillya-ne-panaceya-vid-energokrizi-a-efektivniy-energonosiy-dlya-deyakih-regioniv-ukrayini-_.html)

# 2. COAL IN UKRAINE'S ENERGY PROFILE

## 2.1 Coal-nuclear interplay

Currently, all 15 of the country's operational nuclear reactors are running on nuclear fuel imported from Russia. One reactor is testing alternative fuel, with one-third of the fuel provided by Westinghouse Corporation and the other two-thirds still coming from Russia.

Uranium mining is still active in Ukraine, and its products are exported to Russia. Ukraine's nuclear industry doesn't have a full technological cycle and is dependent on Russia for the critical middle section of the chain – enrichment of uranium. Ukraine also lacks facilities for processing and storing spent nuclear fuel at three of the four nuclear power plants (NPPs). Spent nuclear fuel from the Rivne, Khmelnytsky and South Ukrainian NPPs is shipped to Russia for re-processing and disposal.

Since 2008, the share of nuclear in electricity production has been steadily decreasing, while the share of TPPs (which, since gas and heavy oil co-firing was ceased in 2009, have been running on hard coal only) has been increasing. In 2010 to 2012, a significant part of the thermal power sector was privatized by a single company – DTEK. DTEK's share increased significantly after the controversial privatization of Zakhidenergo Energy Company in 2011.<sup>7</sup> DTEK's production peaked in 2013, when state utility Energoatom's production reached its lowest levels.

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<sup>7</sup> <http://www.epravda.com.ua/publications/2011/11/25/307010/>

## CHANGES IN ELECTRICITY PRODUCTION IN 2009 TO 2014 AND THE FIRST QUARTER OF 2015

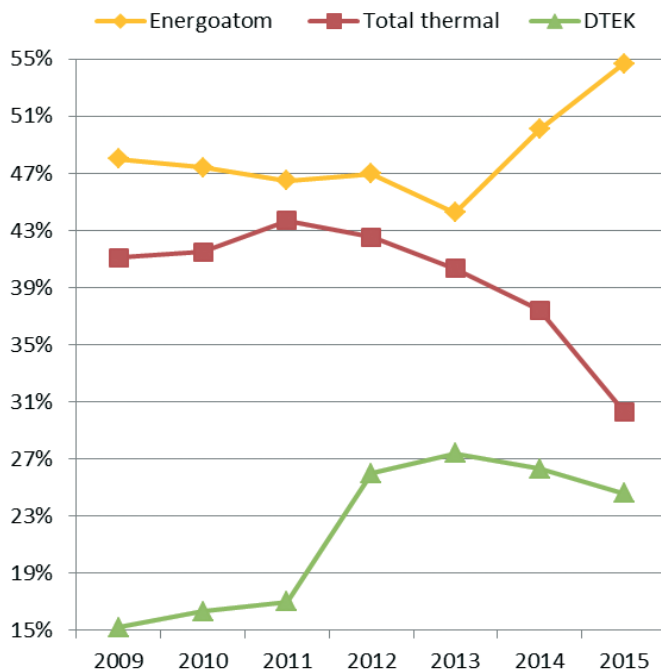


Figure 12: Changes in electricity production in 2009 to 2014 and the first quarter of 2015. Data source: SE Energorynok

In the last two years, the share of nuclear power generation in total electricity supply increased more than 10%. Now, since the fall of 2014, Ukraine is becoming increasingly dependent on nuclear energy, with its fifteen reactors generating more than half of the total electric power supply. Consequently, nuclear fuel supplies, on which Russia still holds a monopoly, are compromising Ukraine's energy security and can be used for political blackmail.

Due to shortages in anthracite supply, now that power output from thermal power has significantly decreased, the artificial dispatch limitations for Energoatom have been gradually lifted, allowing NPPs to increase their load factor and electricity production volumes.

Energoatom claims to be improving its financial performance in 2015, declaring a net profit of 2.26 billion hryvnia in the first six months of 2015. The company saw net losses of 6.49 billion hryvnia in 2014 and 4.76 billion hryvnia in 2013.<sup>8 9</sup>

<sup>8</sup> <http://eircenter.com/news/energoatom-zakinchiv-2013-rik-zi-zbitkom-u-476-mlrd-griven/>

<sup>9</sup> [http://dt.ua/ECONOMICS/u-pershomu-kvartali-energoatom-otrimav-zbitkiv-na-1-32-mlrd-grn-171781\\_.html](http://dt.ua/ECONOMICS/u-pershomu-kvartali-energoatom-otrimav-zbitkiv-na-1-32-mlrd-grn-171781_.html)

In contrast to Energoatom's improved position, DTEK has stepped into an abyss, with net losses amounting to 20.8 billion hryvnia in the first six months of 2015 and 19.6 billion hryvnia in 2014.<sup>10, 11</sup> DTEK, which under the Yanukovych administration enjoyed extremely favorable conditions, has lost its financial benefits coming from priority dispatch and is now suffering from the turmoil in the Donbass region.

Currently, Energoatom is planning to extend the lifetime of 12 reactors, in addition to three that have already undergone this procedure, and is asking for loans from the European Bank for Reconstruction and Development and Euroatom (600 million euros in total).

## 2.2 Overview of energy policy in Ukraine

In Ukraine, energy policy has progressively become a service for private interests since the early 1990s. Despite a rapid decline in the country's greenhouse gas emissions, real energy policy in Ukraine was neither driven by environmental concerns nor aimed at a reduction in fossil fuel use. The massive energy complex inherited by independent Ukraine from Soviet times became excessive and underutilized following the collapse of the Soviet Union, when industrial production plummeted and many facilities or even whole factories were closed down due to disrupted supply and distribution chains, which were originally designed to span across the entire Soviet Union.

Due to its excesses, the energy sector had seen little to no investments for new development projects for many years. The availability of cheap Russian gas and overall energy abundance have contributed to the illusion that excesses guarantee energy security and that business as usual can go on indefinitely. In addition, for two decades energy policy was limited to maintaining business as usual and the privatization of the most lucrative assets by a select few who had political influence.

With capital flows of billions of dollars from the very beginning of the "market era" in 1991, the energy sector became plagued with corruption, starting the first phase of a takeover of Ukraine by emerging oligarchs. The culmination of this period was the case of United Energy Systems of Ukraine, a gas-trading company that was used by Prime Minister Pavlo Lazarenko to divert billions of dollars of public funds and move them offshore. After hoarding so much capital in a short period of time, however, his group failed in its political game, with President Kuchma's group (no strangers to corruption themselves) exposing Lazarenko in a corruption scandal. He was forced to escape to the United States, where he soon faced criminal charges and went to jail. Most of the diverted capital was transferred offshore, where most of the funds were seized and eventually confiscated by the US government in November 2014.<sup>12</sup> Soon after the associated corruption scandal in 1997, Ukraine entered a turbulent period of redistribution of economic and political power, which ended up consolidating several of the oligarchy clans. By the mid-2000s, they managed to legalize their takings and organize acquired assets in corporations.

Starting in the late 1990s, the regional political elite and oligarchs concentrated their political power in Donbass, and privatization of state industries led to rampant corruption.

<sup>10</sup> <http://www.epravda.com.ua/news/2015/09/30/561672/>

<sup>11</sup> <http://www.pravda.com.ua/rus/news/2015/03/13/7061421/>

<sup>12</sup> <http://www.pravda.com.ua/rus/news/2014/11/26/7045403/>

Regional historian Hiroaki Kuromiya described this elite as the «Donbass clan,» a group of people who controlled economic and political power in the region. Prominent members of the «clan» included Viktor Yanukovych and Rinat Akhmetov. The formation of the oligarchy, combined with corruption, led to perceptions of Donbass as «the least democratic and the most sinister region in Ukraine.»<sup>13</sup>

In the 2000s, the Donbass clan also became the most powerful group in the country and started to systematically influence Ukraine's energy policy, promoting further privatization of public utilities and maximizing profits for new companies, most notably DTEK, which resulted in a partial revival of the coal industry.

## **2.2.1 The gas wars**

During the last two decades, energy supplies were used as strong political leverage in Russia-Ukraine relations, which became popularly known as the "gas wars." Tensions first rose when Russia decided to charge Ukraine the world market rate for gas it consumed rather than the lower rate it had been charging since the mid 1990s. In early 2006, Russia began to increase natural gas prices for Ukraine to approach the prices charged in Western Europe. Ukraine claimed that the almost fourfold price increase proposed was politically motivated because of the Orange Revolution that had occurred in Ukraine and the country's election of a president perceived to be more politically oriented towards the West than towards Russia. Russia began cutting gas supplies to Ukraine in an energy price dispute that also became a major political dispute.<sup>14</sup>

The year of 2009 became another landmark because of conflict around gas supplies and a contract with Gazprom that was unfavorable for Ukraine, setting a gas price for the country that was higher than in some EU member states. As a result, in 2010 to 2013 Ukraine was pushed towards a large-scale increase in domestic coal extraction and coal conversion technologies to substitute gas with coal. It was presented by state officials as a strategy in the declared pursuit of energy security, but as was revealed later, the underlying interests had nothing to do with security, and this push became another big threat.

## **2.2.2 A rush for coal**

After the 2010 elections, when Victor Yanukovych became president, energy policy decisively turned to the direct promotion of oligarchy interests, such as a large-scale increase in fossil fuel extraction (including the most environmentally damaging types of fuel such as coal and shale gas) and extensive use of coal in power generation. In the same period, a majority of shares in energy companies Zakhidenergo and Dniπροenergo, with six coal-fired TPPs in total, were privatized by DTEK, owned by oligarch Rinat Akhmetov. Privatization and monopolization of the thermal energy sector was supported and steered by governmental policy, as can be vividly demonstrated by a major policy document – Energy Strategy of Ukraine till 2030 – which proposed plans for expanding

<sup>13</sup> Oliver Schmidtke, ed. (2008). Europe's Last Frontier? [https://books.google.com.ua/books/about/Europe\\_s\\_last\\_frontier.html?id=IPNoAAAMAAJ&hl=ru](https://books.google.com.ua/books/about/Europe_s_last_frontier.html?id=IPNoAAAMAAJ&hl=ru)

<sup>14</sup> Richard M. Levine and Glenn J. Wallace, "The Mineral Industries of the Commonwealth of Independent States", U.S. Geological Survey, September 2009.

the coal sector and was closely linked to the business interests of Rinat Akhmetov and other members of the ruling Party of Regions and President Yanukovich himself.<sup>15</sup>

The original document was drafted in 2005 and 2006 by a group of experts from state-owned research institutes and approved on March 15, 2006. Its strategy was unrealistic from the outset and condemned for its failure to improve the situation in the energy sector. Such critique was repeatedly stated by multiple experts. Estimates and projections in this document were based on exaggerated assumptions of economic growth (+5% annual GDP increase in the base scenario), while real economic dynamics in 2006 to 2012 had nothing to do with the projections, and by 2012 it became obvious that the strategy was totally failing.<sup>16</sup> The revision process for Energy Strategy of Ukraine till 2030 in 2013 ended with no public hearings and no official publication of the document, but the revised document was declared as “adopted” by government on July 30, 2013.<sup>17</sup> Experts characterized the draft of the document as of very poor quality in both technical terms and its projections. According to the document, coal extraction should increase from the current level of 85 million tons to 105 million tons by 2020.<sup>18</sup> This could result in a significant rise in national greenhouse gas emissions – by around 73 million tons CO<sub>2</sub> annually. Fortunately, this document is not considered as a reference point for energy policy debates anymore and will be replaced by a new document Energy Strategy of Ukraine till 2035, drafted by the National Institute of Strategic Studies in Ukraine.

The overall situation in the energy sector dramatically deteriorated under the Yanukovich administration, but all of the previous governments of independent Ukraine certainly contributed to this major failure by creating prerequisites for this course of events. Massive corruption in the state apparatus, namely in the Ministry of Energy and Coal Industry and the Ministry of Ecology and Natural Resources, paved the way for a free ride when it came to resource extraction in Ukraine.

In 2010 to 2013, Ukraine was strongly pushed hard toward large-scale development of “extreme energy” projects, such as fracking for unconventional gas and extensive coal mining. Both initiatives were of an opportunistic and speculative nature and had little chance for success because of real-world limitations, such as a lack of technologies and expertise, the complex geological structure of eastern Ukraine and an over-estimation of accessible resources.

### **2.2.3 Case study: coal gasification incentive in Ukraine**

In January 2012, former Minister of Energy and Coal Industry of Ukraine Yuriy Boyko stated that Shell and Ukrainian authorities had agreed on the construction of three coal gasification plants. In the last ten to fifteen years, Shell has sold 19 licenses for the Shell Coal Gasification Process in China, mainly for the production of chemicals such as methanol, ammonia and fertilizers by thermo-chemically processing coal, which could replace natural gas as a feedstock. Another idea was to deploy other coal conversion technologies, such as the use of coal-water slurry fuel in heating utilities instead of natural gas. These

<sup>15</sup> [http://smarteconomy.typepad.com/smart\\_economy/2011/11/ukraines-watergate-kopanka-coal-scandal-could-lead-to-western-sanctions-against-the-yanukovich-regim-2.html](http://smarteconomy.typepad.com/smart_economy/2011/11/ukraines-watergate-kopanka-coal-scandal-could-lead-to-western-sanctions-against-the-yanukovich-regim-2.html)

<sup>16</sup> <https://www.kyivpost.com/content/business/imf-improves-gdp-growth-forecast-for-ukraine-in-2013-by-04-percentage-points-330262.html>

<sup>17</sup> <http://www.unian.ua/society/818547-kabmin-uhvaliv-onovlenu-energostrategiyu.html>

<sup>18</sup> <http://www.interfax.co.uk/ukraine-news/ukraine-plans-to-reach-extraction-of-105-m-t-of-coal-a-year-says-president/>

technologies have proven to be extremely environmentally damaging in China, where their deployment resulted in a rapid depletion of water resources and contributed to catastrophic air pollution.<sup>19</sup>

Chinese investors in 2012 confirmed their interest in the construction of a coal gasification plant in the city of Severodonetsk in Donbass. The project, however, faced complications as early as the feasibility study stage, when it appeared that there was not enough expertise in Ukraine to prepare a reasonable and technically adequate study. Despite this fact, on 26 December 2012 China Development Bank and Naftogas Ukraine signed a credit agreement of 3.656 billion US dollars for the development of coal gasification facilities and renewal of the coal mining sector. Even with the dramatic political changes and ongoing war in Donbass, the Chinese government, as of summer 2015, hasn't dismissed this agreement. This suggests that China has not developed a new agenda for Ukraine yet but maintains long-term interests in the country.

Such facilities could in theory produce syngas as a feedstock for big chemical plants in Ukraine, which are operated by Ostchem Holding, a part of DF Group owned by oligarch Dmitry Firtash, who is currently being prosecuted by the FBI.

Despite multiple statements from Ukrainian officials about the economic benefits of coal conversion technologies in 2010 to 2013 and assertions that a program for substituting natural gas with coal can fix Ukraine's deteriorating energy sector, no such developments were brought to a level of technically feasible projects.

#### **2.2.4 A new course**

The new course of energy policy in Ukraine is just starting to emerge, and it's being steered mainly by external factors rather than an authentic national concept. It still does not address the full potential of a major increase in energy efficiency and energy-saving measures or aim for a reduction in total energy consumption. Furthermore, Ukraine still has no proper and transparent energy balance, lacking representative data, which is the fundamental basis for consistent and appropriate energy policy. Adequate information on production, consumption, imports and exports of energy sources is not available to the general public in Ukraine. Oligarchs are still influencing energy policy and opposing introduction of accountability and clear rules in the energy sector, while trying to promote their own interests at public expense.

Since 2014, governmental policy in the coal sector has been limited to crisis management. The main executive body in the field – the Ministry of Energy and Coal Industry – is focusing on maintaining supplies of coal to ensure the stability of the national energy system while overlooking systematic solutions and any potential for structural shifts in energy sector. As of the fall of 2015, governmental efforts to organize alternative supplies of anthracite coal (from sources other than Russia) have not been effective and the energy security situation remains precarious.

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<sup>19</sup> Greenpeace: Thirsty Coal: A Water Crisis Exacerbated by China's New Mega Coal Power Bases <http://www.greenpeace.org/eastasia/global/eastasia/publications/reports/climate-energy/2012/Greenpeace%20Thirsty%20Coal%20Report.pdf>



Strategically, coal is still being considered as a pillar of Ukraine's energy system, and there is little ambition to deploy renewable energy and the huge potential of energy efficiency is not being systematically addressed. The new Energy Strategy till 2035, which is currently waiting for comments from a number of ministries, still fails to fully recognize the potential of renewable energy deployment and envisages maintaining coal-fired capacities at the current level up to 2030. Along with transparency, a new energy policy model with a focus on energy efficiency and deployment of renewables is essential both for reducing greenhouse gas emissions and for overcoming the country's dependence on imported fossil fuels and nuclear fuel from Russia. This is a major challenge which Ukraine is currently incapable of addressing on its own.

## 2.3 EU-Ukraine cooperation in the energy sector

### 2.3.1 Technical assistance in the coal sector

The unprecedented scale of corruption in Ukraine's energy sector has been largely overlooked or ignored by the European Commission, international financial institutions such as the EBRD and World Bank and other organizations. This has resulted in an inefficient use of funds in various technical assistance projects, which were intended to support energy policy reform.

Most notably, the European Commission financed two technical assistance projects in the coal sector, both aimed rather at business-as-usual scenarios rather than at a full-scale re-structuring of the coal sector.

The first project, the Coal Sector Policy Support Programme, took place from 2008 to 2011 and had five components, with overall management organized by Human Dynamics KG, an Austrian consultancy firm. The project was focused on coal mining, and the findings from the environmental component of the program are publicly available.<sup>20</sup> The project's research team encountered multiple problems and was not able to access some essential information. Mine operation data and other essential information was classified, and the former Ministry of Coal Industry would not provide such data. Ukrainian authorities maintained close control over data that should have been publicly available in an effort to hide widespread corruption.

The second project, Demonstration, Dissemination and Deployment of Clean Coal Technologies and Carbon Capture and Storage in Ukraine, was undertaken by the Coal Energy Technology Institute of the National Academy of Sciences of Ukraine in 2010 to 2014.<sup>21</sup> Project results were published in two studies.<sup>22,23</sup> This project focused on coal-fired power generation and technology options for its continued development in Ukraine. Assessing the potential for implementing carbon capture and storage (CCS) was one of the components of the project. Significant funds were granted for attempts to promote CCS in

<sup>20</sup> [https://www.researchgate.net/publication/228311176\\_Ukraine\\_Coal\\_Sector\\_Strategy\\_Analysis\\_Policy\\_Options\\_for\\_Environmental\\_Management\\_to\\_2030](https://www.researchgate.net/publication/228311176_Ukraine_Coal_Sector_Strategy_Analysis_Policy_Options_for_Environmental_Management_to_2030)

<sup>21</sup> [http://eeas.europa.eu/delegations/ukraine/projects/list\\_of\\_projects/243936\\_en.htm](http://eeas.europa.eu/delegations/ukraine/projects/list_of_projects/243936_en.htm)

<sup>22</sup> <http://www.cetipproject.com/PICCTESUbook.pdf>

<sup>23</sup> [http://www.cetipproject.com/Tom\\_II\\_GL\\_TP.pdf](http://www.cetipproject.com/Tom_II_GL_TP.pdf)

Ukraine, but the whole discourse around CCS in Ukraine was misleading and disconnected from the actual status of obsolete and decrepit thermal power generation facilities in Ukraine, which have seen little to no investment in modernization in the last two decades and have an average age of 45 to 50 years.<sup>24</sup>

Neither project had any immediate effect on policymaking in the coal sector, which remained ineffective and devoid of any kind of transparency.

### **2.3.2 Ukraine and the Energy Community**

In 2011, Ukraine became a full-fledged Energy Community member and committed to implementing a whole range of European directives and regulations that would harmonize its legislation in the energy sector with European legal and regulatory frameworks. Changes should have been introduced in natural gas, electricity, environment, renewables sectors and statistics. In reality, however, up to 2014 the implementation process was more of a formality, and actual adaptation of EU directives into national legislation was lagging far behind agreed deadlines or being performed with critical distortions.<sup>25</sup>

Some directives were implemented with violations. For example, the Law on the Principles of Electricity Market Operation adopted in October 2013, despite being generally necessary for energy reform in the country, contained a range of provisions which deviated from European principles and standards: specifically, it preserved cross-subsidizing. Comments expressed by the World Bank and the Energy Community were not fully taken into account.

Upon signing the Energy Community treaty in 2010 and formally committing to “civilized” development and a shared energy policy framework, the oligarchy’s government was expecting to be embraced by European bureaucracy in this critical geopolitical project without being required to alter the models of internal policymaking and that business in Ukraine’s energy sector could continue to be unchecked and steered according to mafia rules.

After the treaty was signed, a set of four export-oriented projects was proposed for funding as priority projects of the Energy Community but eventually rejected by the organization’s secretariat in 2013 due to infringements of the treaty. The idea was to construct new coal-fired units at the Burshtyn and Dobrotvir thermal power plants and two new cross-border transmission lines to enhance the connection of those two TPPs with European electric power grid. All four projects were promoted by DTEK.

In the fall of 2013, when it became obvious that joining the EU energy market demands transparency and profound change in how the energy sector is governed, the Yanukovych administration made a political U-turn towards Russia in an effort to maintain business as usual. The people of Ukraine, however, decided otherwise and stood up against large-scale political corruption. After the Euromaidan revolution, Ukraine decisively stepped into the European integration process.

During the Euromaidan events, on 10 February 2014, Ukraine’s government was forced to sign a Memorandum of Understanding with the Energy Community secretariat on

<sup>24</sup> <http://www.energypost.eu/ukraines-coal-power-plants-need-planned-phase-ccs/>

<sup>25</sup> DiXi Group, 2014 report: “Ukraine and Energy Community: still does not fit” <http://ua-energy.org/en/post/44023>

“Establishing an Implementation Partnership between the Ministry of Energy and Coal Industry of Ukraine and the Secretariat of the Energy Community.”

The Association Agreement also added incentives for adapting the Ukrainian energy sector to the standards of the European Union. Ukraine signed the political provisions of the Association Agreement on 21 March 2014 and the provisions of the remaining parts on 27 June 2014. Energy provisions, including commitments related to the Energy Community Treaty, are an important part of the Association Agreement. Now, Ukraine’s membership in the Energy Community Treaty provides a full range of instruments for reforming the energy sector, which is urgently needed.

On the other hand, the integration of Ukraine into the pan-European general energy framework is important for Europe’s energy security. The European Commission is currently participating in the reform process in Ukraine’s energy sector using a set of success indicators within a budget support program granted to the Ministry of Energy and Coal Industry, with each consecutive set of funds coming after successful achievement of goal indicators.

For the thermal power sector, a key issue is the implementation of Large Combustion Plants Directive 2001/80/EC and Industrial Emissions Directive 2010/75/EC. In October 2013, the Ministerial Council of the Energy Community adopted two important decisions aimed at further limiting emissions from large combustion plants. The first decision provides for the opportunity to apply flexible instruments for the implementation of Directive 2001/80/EC throughout the transition period, so as to facilitate the achievement of the document’s objectives without reducing the ambitions. The second decision concerns the implementation of more ambitious goals towards the reduction of emissions into the atmosphere by large combustion plants (Directive 2010/75/EC) starting in 2018.

According to this decision, Ukraine was obliged to draft relevant programs for a gradual reduction of total yearly emissions of hazardous pollutants (SO<sub>2</sub>, NO<sub>x</sub> and dust) from thermal power plants with a rated efficient heat capacity of 50 MW or more and develop a strategy to deliver compliance with the emission limit values set for existing plants (formally defined as commissioned before 1992, which covers all of Ukraine’s large combustion plants (LCPs) except one unit at Starobeshivska TPP).

In 2014 and 2015, with technical assistance from the EU, Ukraine developed the National Emission Reduction Plan (NERP) as a strategy for the implementation of Large Combustion Plants Directive 2001/80/EC and Industrial Emissions Directive 2010/75/EU.

The NERP, which was submitted to the Energy Community Secretariat in April 2015, indicates that the influence of industry (namely DTEK) on energy policy in Ukraine remains strong and operators of LCPs can successfully promote their commercial interests, while the state is unable to implement effective reforms in the energy sector and steer the re-structuring of the excessive and obsolete thermal power sector, which is much needed for protecting the environment and people’s health.

In order to have a real strategy for reducing air pollution and an overall climate protection policy framework, it is necessary to conduct a comprehensive analysis on pathways for re-structuring the whole energy sector and long-term exit strategies for the coal industry.

The Ministry of Energy and Coal Industry and the government as a whole are still incapable of developing and enforcing coherent policies that could change Ukraine's power generation landscape. Current policies (which are in conflict with the objective situation in the coal sector and set unrealistic goals) support the continued functioning of an excessive and decrepit coal fleet with extremely high levels of SO<sub>2</sub> and dust emissions.

On the bright side, Ukraine has great potential for developing renewable energy sources (wind, solar, biomass), as evidenced by the kick-start and development of this sector between 2010 and 2013. Renewable energy is one of the few areas where the implementation of EU directives as a member of the Energy Community was fairly effective. One of the deterring factors was obligatory "local content" quotas in renewable energy projects, which was forcing developers to purchase a certain percentage of components and services in Ukraine during construction. After adoption of a law titled «Amendments to some laws of Ukraine to ensure competitive conditions for the production of electricity from alternative energy sources» on 12 June 2015, these distortions were rectified. The new law introduced a stimulating factor for investors: an increase in the «green tariff» if the renewable power generation facility is commissioned using some components manufactured in Ukraine and/or with involvement of local contractors.



Industrial landscape near the city of Horlivka.  
Photo by Vladimir Lapshyn

# 3. CURRENT STATUS OF THE COAL INDUSTRY

## 3.1 Structure and ownership

In the 2000s, Ukraine's coal industry was gradually privatized in favor of one business group. The coking coal sector was captured first, following by progressive monopolization of the thermal coal market. The large financial/industrial group System Capital Management became the main player in the coal market and successfully created solid, vertically integrated structures along the production chains of coal-coke-metal (Metinvest) and coal-generation-electricity (DTEK). These two companies control both the markets for steel and thermal power and the major share of investment streams flowing in both industries. System Capital Management Corporation is privately owned by Ukrainian oligarch Rinat Akhmetov.

Asset management of the vertically integrated DTEK Corporation is organized through a holding structure registered in Netherlands. Senior company DTEK Holdings B.V. has three subsidiaries – DTEK Energy B.V., DTEK Renewables B.V. and DTEK Oil&Gas B.V. Coal mining and thermal power generation constitute the major share of DTEK assets and are managed through DTEK Energy B.V. The holding also includes DTEK Finance B.V. and Swiss-registered coal trading company DTEK Trading S.A., which is responsible for coal exports and imports.

### 3.1.1 Mining

The most productive mines were privatized in the 2000s, and most of them are now incorporated into DTEK Energy. The mines that are still owned by the state are mostly old and not very productive, and their easily accessible reserves are depleted. In 2012, DTEK produced 39.7 million tons of –run-of-mine coal, which accounted for approximately 46.1 % of Ukraine's total coal production. That year, DTEK owned, leased or had concession rights to operate 31 coal mines and 13 coal enrichment plants, including three mines and one

coal enrichment plant in Russia.<sup>26</sup> Along with DTEK, several minor private companies (Sadovaya Group and Lubel Coal Company) were active in hard coal mining but as of 2015 their operations have been halted or terminated.

State-owned mines outnumber private ones, but a significant number of them are at the end of their lifecycle and have high production costs. The average annual output of most of the state-owned mines is less than 800 thousand tons, while DTEK's two most productive mines alone produced 17 million tons of coal in 2012. In 2009, the government planned to launch the final phase of privatization with a sale of 99 operational mines, but as of 2014 most of those mines remained in state property and four were shut down.

In 2014, a number of the mines were flooded<sup>27</sup> as a result of electricity cut-offs during military conflict, and some others were taken under control by separatists. In April 2015, the Minister of Energy and Coal Industry stated that Ukraine controls only 36 (only 23 in Donbass region) of the 95 state-owned mines.<sup>28</sup> But despite its own losses, in 2014 DTEK significantly increased its share of coal production (which had declined in Ukraine) to 57.1%. All anthracite mines (both DTEK and state-owned) are now located in territory uncontrolled by Ukrainian authorities.

### COAL PRODUCTIONS IN 2014, MILLION TONS

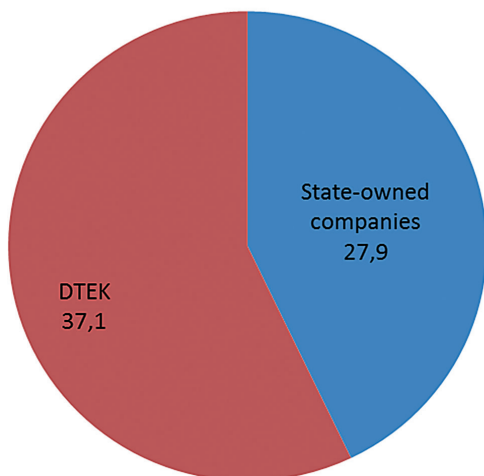


Figure 13: Coal production in 2014. Data sources: DTEK and Ministry of Energy and Coal Industry

<sup>26</sup> DTEK annual report 2012 <http://www.dtek.com/library/file/annual-report-2012-en.pdf>

<sup>27</sup> <http://kp.ua/politics/469776-v-donetskoi-oblasty-zatopleny-desiat-shakht-dve-uzhe-ne-vosstanovyt>

<sup>28</sup> Demchyshyn: out of 95 mines Ukraine controls only 35, the rest – under occupiers <http://www.pravda.com.ua/news/2015/04/20/7065280/>

### 3.1.2 Power generation

Ukraine has a total of 14 large-scale thermal power plants organized in five generation utilities. DTEK Energo incorporates three electricity generation companies: Vostokenergo, Dneproenergo and Zakhidenergo, with nine coal-fired TPPs in total. Donbassenergo operates two power plants and Centerenergo operates three.

In 2013, energy company Donbassenergo (operator of two TPPs in the Donbass region) was privatized in a very controversial way, which added heat to escalating opposition to the Yanukovych administration. On 20 June 2013, two companies, Energoinvest Holding in Ukraine and Energoinvest Holding BV in the Netherlands, were registered on the same day. On 21 August 2013, the state sold a 61% stake in Donbassenergo to Energoinvest Holding. After privatization, Igor Gumenyuk declared himself the owner and end beneficiary of Energoinvest Holding. Until the 2000s, Gumenyuk had held the chief executive officer position at ARS, a coal trading company founded by billionaire Rinat Akhmetov. ARS was a major player on the steam and coking coal markets before the creation of SCM and its subsidiary DTEK.

The ultimate ownership of Dutch company Energoinvest Holding BV was hidden behind the Whitebridge Resources Foundation, registered in the UK. Investigators claim that Whitebridge Resources Limited was used for a long time by Akhmetov and members and donors of the Party of Regions for optimizing export/import operations and other kinds of obscure financial transactions.

The major share of the thermal power generation sector is now in the hands of the cartel led by DTEK. Together with Donbassenergo, they own 11 of the 14 TPPs in Ukraine, while the three others remain state property managed by Centerenergo.

## 3.2 Overview of the coal mining sector

Eastern Ukraine has a long historical legacy of coal mining. In the 19<sup>th</sup> century, coalfields in the Donbass region provided most of the coal supply in the Russian empire. During Soviet times, too, eastern Ukraine was one of the main industrial centers of the Soviet Union, fueling its rapid and in many ways violent industrialization.

In its maturity, Donets Basin was the largest coal production source not only among the coal-mining regions of the Soviet Union, but also worldwide. Coal extraction in the coal fields of the Donbass region, which were exploited for more than two centuries, peaked in the 1970s. Although coal production in the whole of the USSR was on the rise until 1989, coal extraction in Donbass peaked much earlier, namely in 1976, when extraction slightly exceeded 200 million tons. In the late 1970s, coal mining in Donbass entered a steady decline, but no efforts were made for economic diversification and environmental remediation in mining areas. As a result, the local population remained tied to the declining coal industry with few to no employment alternatives and faced negative effects from escalating environmental degradation.

For Ukraine, the coal industry has been a toxic legacy, constantly causing a wide range of serious social and environmental problems that have required immediate and systematic



solutions, but the problems of the mining sector have been, at best, ignored – or even used by those in power for financial advantages. Ukraine's mines are the oldest in the Central and Eastern Europe (CEE) region; an average mine is about 45 years old. More than 90% of them have not been upgraded in the last 25 years.

## COAL PRODUCTION UKRAINE BY TYPE OF COAL, THOUSANDS METRIC TONS

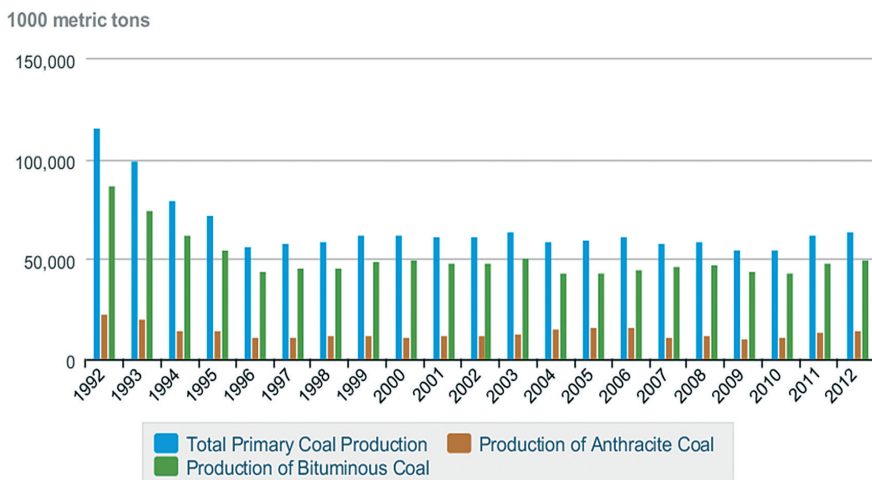


Figure 14: Net coal production in Ukraine. Source: U.S. Energy Information administration

Most of the easily accessible coal deposits were depleted before the 1990s. Therefore, unlike in most coal-producing countries, mining in Ukraine has involved the development of deposits in very complex geological conditions, in particular with very deep and thin coal seams. The average depth of the coal seams is more than 720 meters, with about 20% of mines at a depth of 1,000 to 1,400 meters, and the average thickness of coal seams in Ukrainian mines is approximately 1 meter. In Donbass, about 85% of the coal is contained in seams up to 1.2 meters thick, while only 15% of seams are thicker.

In the Lviv-Volyn Basin there are only 13 mines, all of them state owned. Nine are located in the Lviv region and four in the Volyn region. In 2014, these mines produced only two million tons of coal, or about 2% of the total coal extraction in Ukraine. These mines are poorly equipped and produce coal with high ash content (up to 45%).<sup>29</sup>

For decades, the state was providing direct support for technically obsolete and unprofitable state-owned mines instead of spending funds on their shutdown and addressing environmental and social issues in mining regions. This has resulted in serious long-term negative consequences not only for coal-mining regions (most notably eastern Donbass), but for the economy of Ukraine as a whole.

<sup>29</sup> [http://gazeta.dt.ua/energy\\_market/vugillya-ukrayini-ne-donbasom-yedinim\\_.html](http://gazeta.dt.ua/energy_market/vugillya-ukrayini-ne-donbasom-yedinim_.html)



Direct subsidies to coal mining alone in 2012 reached 1.3 billion Euros or 3.8% of the state budget. In 2013, governmental expenses on subsidies for state-owned mines increased further, exceeding 1.5 billion euros. Most of the subsidies went to compensation for the disparity between the regulated coal price and production costs, which largely depended on the cost of mining equipment and construction materials.

### COMPARISON BETWEEN COAL NET COSTS AND PRICE IN UKRAINE (IN HRYVNIA)

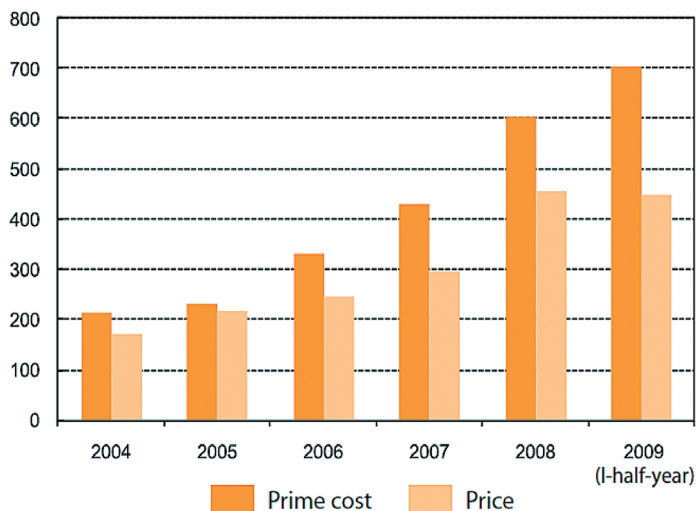


Figure 15: Comparison between coal net costs and price in Ukraine (in hryvnias). Source: National Ecological Centre of Ukraine

In 2003, experts from the Razumkov Centre carried out a study and came to the conclusion that private intermediary companies with the help of state executive authorities were monopolizing both the coal sale market and the market for mining equipment and materials. Their analysis suggested that "a possibility to obtain super-profits that are available to powerful private companies associated with state authorities, is a key reason of inefficiency of efforts to introduce transparent market mechanisms into the coal sector as well as intersectoral relations, and is a barrier to legal privatization."<sup>30</sup>

<sup>30</sup> Razumkov Centre. Coal Sector Re-structuring: Intentions and Outcomes. // National Security and Defence. — 2003 — No. 8.

## INTERSECTORAL COMMODITY AND MONETARY FLOWS

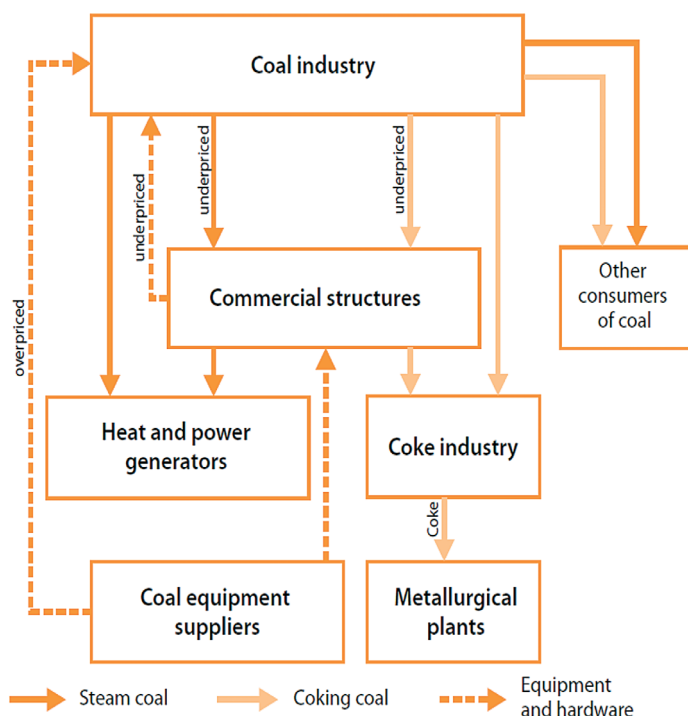


Figure 16: Intersectoral commodity and monetary flows.  
Source: Razumkov Centre

This situation, the experts suggested, resulted in bankruptcy for many mines. Since 2006, uncompensated losses caused mining companies' debts to accumulate; this was often done intentionally so a company would declare bankruptcy and could be privatized for its debts or at a liquidation price. The main beneficiaries under this arrangement were Corum Group and DTEK, both incorporated in SCM Holding, owned by Rinat Akhmetov.

Under the Yanukovych administration, coal extraction rapidly increased until the spring of 2013, when artificial expansion of the sector resulted in over-production.<sup>31</sup> Later in 2013, a major corruption scandal broke out, when the role of Yanukovych's clan in widespread corruption in the coal sector was revealed by a series of journalistic investigations.<sup>32</sup>

<sup>31</sup> TEXTY: The state allocates billions for coal production, which turns useless [http://texty.org.ua/pg/article/editorial/read/43994/Derzhava\\_vydilaje\\_miljardy\\_na\\_vydobutok\\_vugilla\\_jake](http://texty.org.ua/pg/article/editorial/read/43994/Derzhava_vydilaje_miljardy_na_vydobutok_vugilla_jake)

<sup>32</sup> Economic Pravda: Coal of the "Family" <http://www.epravda.com.ua/rus/publications/2013/06/10/378953/>

## GROSS COAL EXTRACTION IN UKRAINE, MILLION TONS

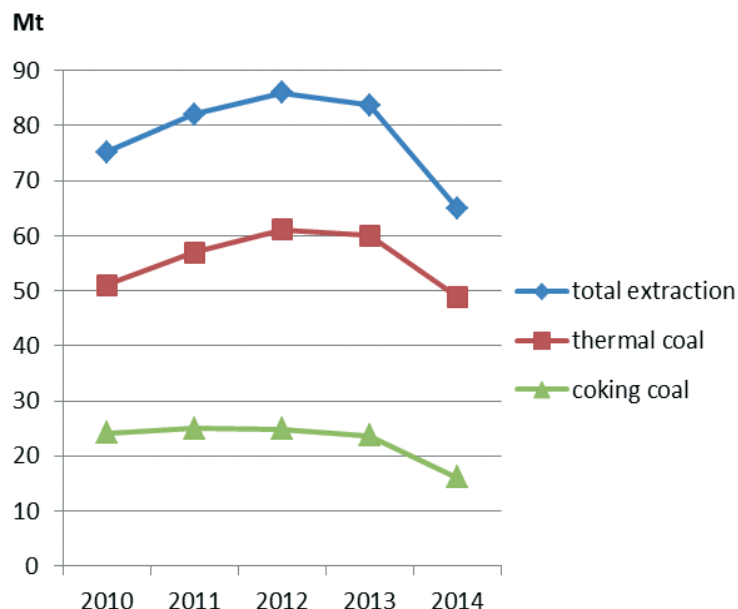


Figure 17: Gross coal extraction. Data source: Ministry of Energy and Coal Industry

In 2014, Ukraine, following the fall of the Yanukovych regime, saw significant political, economical changes and experienced war in its territory. The country's energy sector was disrupted by a politically motivated blockade of gas supply from Russia and the collapse of coal mining infrastructure in the Donbass region during military conflict, which is still ongoing. A significant portion of Ukraine's coal mining is now situated within occupied territories. This caused a 60% decline in domestic coal extraction, which in turn resulted in anthracite shortages for Ukrainian TPPs in the fall of 2014. Currently, Ukraine has a deficit of anthracite, which nearly half of the TPP fleet uses, while a number of anthracite mines in Donbass were destroyed during the conflict. According to the Ministry of Energy and Coal Industry, as of June 2015 there are 36 coal mines in the territory under government control, with 23 mines in Donbass producing high-volatile coal but not anthracite.

Disrupted coal supplies led to a need for coal imports, and the post-revolutionary government did not manage to create new stable resource flows. In November 2014, corruption scandals broke out around coal supplies for state-owned coal TPPs from South Africa and Russia. Because of poor management and corruption, state-owned coal TPPs experienced fuel shortages in December 2014. A number of units ceased operations, leading to a capacity deficit in the winter of 2014-2015, which in turn caused rolling blackouts across the country.

Because of ongoing military conflict and extensive infrastructure damage in the Donbass

region, where DTEK has a big part of its assets, restoration of former levels of production and revenues is practically impossible. One of DTEK's most productive anthracite mines, Komsomolets Donbassa (which provided 17% of DTEK's coal production), was flooded after extensive targeted shelling in November 2014<sup>33</sup> and most of the above-ground mine infrastructure was severely damaged. The state mining sector in the Donbass region experienced even more damage, with more than ten mines flooded.

### 3.3 Overview of the thermal power sector

There are 15 thermal power plants in Ukraine consisting of 101 units and 9 CHP plants with a total of 12 units. The TPPs have 93 coal-fired units, with a total capacity of 21,853 MW, and 8 gas-fired units, with a total capacity of 5,400 MW. The CHP plants have 4 coal-fired units, with a total capacity of 404 MW, and 8 gas-fired units, with a total capacity of 1,711 MW. The total installed capacity of all the thermal power plants is 29,368 MW.<sup>34</sup>

#### TOTAL INSTALLED CAPACITIES IN UKRAINE 2011, MW

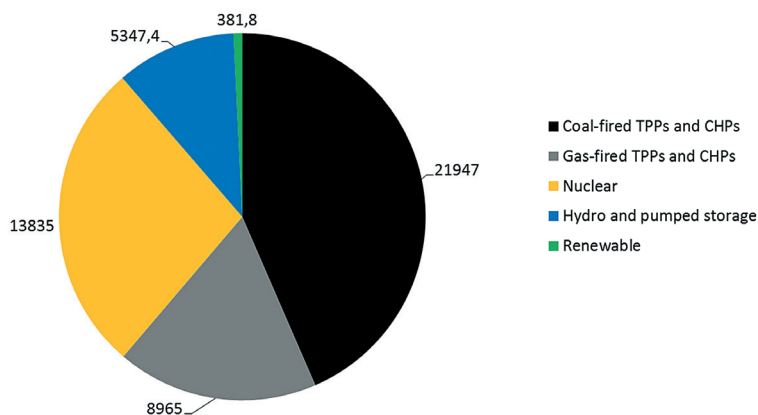


Figure 18: Total installed capacities. Source: National energy company Ukrenergo

All of the gas-fired units at TPPs were not in use for a long time because of high prices for natural gas. Most of them are still operational. In the winter of 2014-2015, in light of generation capacity shortages caused by the conflict in Donbass, one gas-fired unit at Tripylska TPP was used to cover peak loads.

Coal-fired units at TPPs constitute 41% of Ukraine's total installed capacities of 53.8 GW.

<sup>33</sup> [http://gazeta.ua/articles/np/\\_sahta-komsomolec-donbasu-potrapila-pid-artilerijskij-obstril-1-lyudina-zaginula-2-poraneni/592941?mobile=true](http://gazeta.ua/articles/np/_sahta-komsomolec-donbasu-potrapila-pid-artilerijskij-obstril-1-lyudina-zaginula-2-poraneni/592941?mobile=true)

<sup>34</sup> Study on the need for modernization of large combustion plants in Energy Community <https://www.energy-community.org/pls/portal/docs/2652179.PDF>

Most of these units were designed for the combustion of hard coal with oil or natural gas in flexible proportions but later retrofitted to minimize the use of gas. Now, coal accounts for 98% of fuel used at Ukraine's TPPs.

The baseload efficiency of thermal power units (most of which are still not retrofitted) in Ukraine averages around 30 to 32%; a significant portion of them are used to cover peak loads with frequent start-up and shut-down operations, which reduces efficiency even further. The TPPs' current technical and economic parameters lag behind the level achieved between 1975 and 1980. Fuel consumption has increased from 340 to 345 grams of coal per 1 kWh in 1980 to 405 grams of coal per 1 kWh in 2006, mainly because of the deterioration of turbines and auxiliary equipment (fuel consumption at TPPs in Europe is 280 to 320 grams of coal per 1 kWh on average).

Hours in operation	Number of units in 2012	Share of total capacity, %	Expected remaining lifetime, years
> 320 000	2*	0,72	0
300-320 000	11	7,28	0-3
250-300 000	43	37,36	5-8
200-250 000	26**	24,16	10-15
200-150 000	8***	8,59	
< 150 000	9+2****	21,90	

\* 2 turbines with 5 boilers at Dobrotvir TPP

\*\* of which 2 units are gas-fired units, 600 MW total

\*\*\* of which 6 are gas-fired units, 4,800 MW total

\*\*\*\* In 2013, 1 of 2 new IGCC units (151.5 MW each) was put into operation, run by coke and blast furnace gases at the Alchevsky steel mill.

Ukraine has a large fleet of coal-fired TPPs that are excessive and technically obsolete. The number of hours in operation for 70% of the thermal generation equipment significantly exceeds 200,000 and is approaching 300,000 hours. The exhaustion of technical resources, low efficiency and high emissions of hazardous pollutants already indicate that 13 units with a total capacity of 2.2 GW should be decommissioned. In the next ten years, 12 GW of coal capacity must be decommissioned (more than 40% of the total installed capacity of the thermal power sector).

Despite this dire reality, Ukraine's electrical grid operator UKRENERGO is projecting an increase in installed capacities of coal-fired TPPs of 4.7 GW by 2024.<sup>35</sup> DTEK Corporation still envisages maintaining the current share of coal in Ukraine's energy mix up to 2030, thereby preserving its energy monopoly status.

Maximum wintertime capacity utilization was around 31 GW in January 2012. At that time, coal-fired units amounting to around 5 GW were running in baseload, with another 6 GW used for peak load coverage. The average load factor of Ukrainian TPPs is very low – around 35%.

<sup>35</sup> According to the draft "Plan for development of Ukraine's energy system for next ten years" [http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art\\_id=244996590&cat\\_id=244946928](http://mpe.kmu.gov.ua/minugol/control/uk/publish/article?art_id=244996590&cat_id=244946928)

At most of the TPPs, while some units are running, others are undergoing repairs. In the summer, capacity utilization of the thermal power plants is even lower and most of them run in peak-load mode with frequent start-stop operations, which leads to decreased efficiency and higher emissions.

## DAILY LOAD CURVE OF UKRAINE'S JOINT ENERGY SYSTEM, JANUARY 2013 DATASET

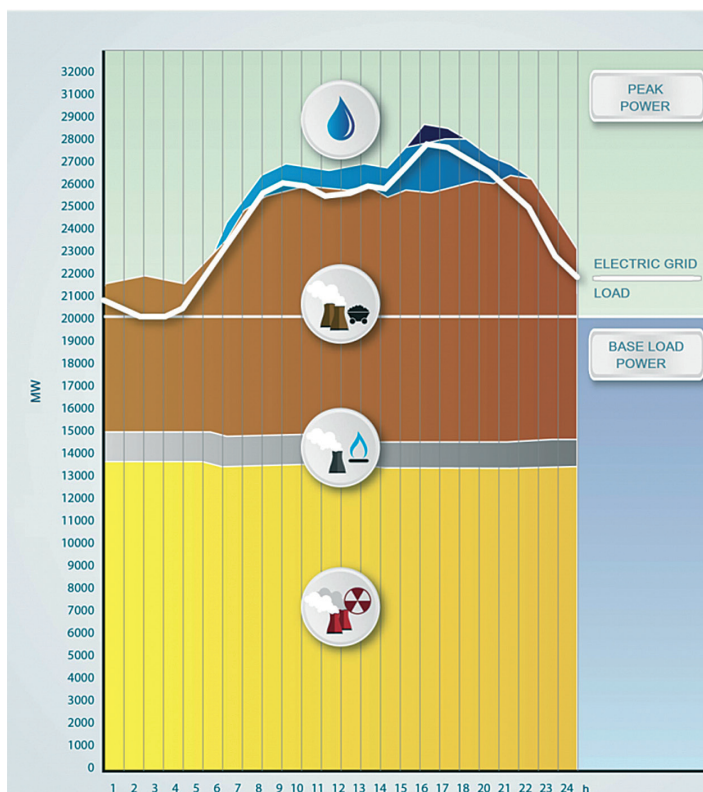


Figure 19: Daily load curve of Ukraine's joint energy system, January 2013 dataset. Yellow is nuclear, brown is coal, gray is CHP (gas-fired in cities), blue is hydro and dark blue is pumped hydro storage. Data source: Ukrenergo

In 2014 and 2015, one third of the TPP fleet (around 30 power units) experienced coal supply shortages (anthracite, to be more precise). Because of this, Ukraine has a significant capacity deficit, especially in peak load hours. The whole energy sector is now in a critical situation and the government is focused on short-term solutions for the energy crisis. This gives industry the opportunity to promote new coal as a solution to energy security, but the status of the coal mining sector is playing against that. The crisis also reveals the structural inadequacy of the power generation sector and the lack of proper management and regulation at the national level. Until recently (up to the moment when

TTPs were faced with coal shortages), significant coal capacities (up to 6 GW) were used to cover the variable part of the load curve with frequent start-stop operations. Currently, since coal supplies were interrupted, maneuverable gas-fired units, which were set into reserve in the 2000s, can potentially be put back on-line.

### 3.3.1 Heating

District heating systems in Ukraine are outdated and inefficient. Most of the centralized heating infrastructure is powered by heating plants or industrial boilers. The share of cogeneration sources in total heat supply (CHPs and heat utilization from thermal power plants, nuclear power plants and industrial facilities) is around 20%.<sup>36</sup> Central heating utilities are mostly state owned.

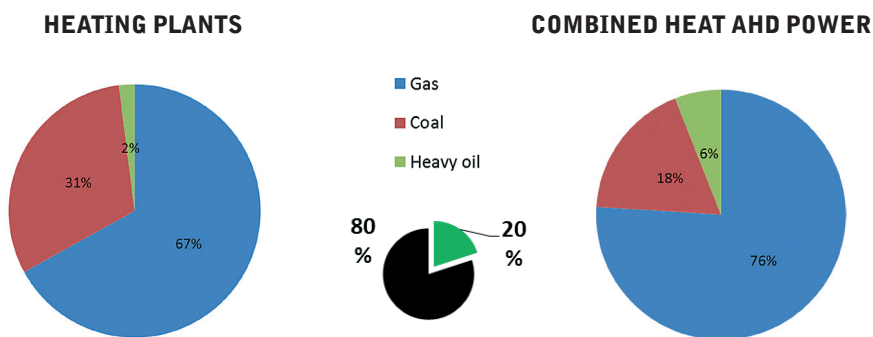


Figure 20: Fuel consumption in the heating sector.  
Data source: Bioenergy Association of Ukraine

The state of the equipment at most of the heating plants is poor; it needs reconstruction or complete replacement. Equipment at most CHPs is also obsolete, does not meet environmental standards and regulations and requires reconstruction and modernization. The main fuel for the heating plants is natural gas, while coal is also widely used, especially in eastern Ukraine. Most of the small heating plants (up to 2.0 MWth) which are widely used for heat production are very old and outdated, ineffective and not equipped with flue gas cleaning systems. In addition, they generally use low-quality coal with high ash content.

In southeastern Ukraine, coal is also used in private buildings and greenhouses in furnaces. The total capacity of the individual heating units (mostly gas-fired boilers) is around 50 GWth, or 25% of the capacity of central heating systems, which exceeds 200 GWth.

<sup>36</sup> Bioenergy Association of Ukraine. "The economic rationale for switching heating to solid bio-fuels" [http://www.irf.ua/knowledgebase/publications/ekonomichne\\_obrahuntuvannya\\_dotsilnosti\\_perekhodu\\_na\\_opalennya\\_tverdim\\_biopalivom\\_garmonizatsiya\\_ukrainskikh\\_standartiv\\_ta\\_standartiv\\_es/](http://www.irf.ua/knowledgebase/publications/ekonomichne_obrahuntuvannya_dotsilnosti_perekhodu_na_opalennya_tverdim_biopalivom_garmonizatsiya_ukrainskikh_standartiv_ta_standartiv_es/)



Photo by Oleg Savitsky



# 4. UKRAINE'S COAL EXTREMES

## 4.1 Disrupted privatization

In 2013, Ukraine's revised Energy Strategy for 2030 (which in fact was prepared by the Effective Management Fund, which is directly linked with SCM) envisaged full privatization of thermal power and coal mining, while only nuclear power plants and large hydro should remain under state control. Although the government promises competitive access to privatization, in practice most of the enterprises end up in the hands of Rinat Akhmetov.

Monopolization of production and supply of electricity became the hallmark of 2012. Experts point out that, despite the entry in 2011 into the European Energy Community treaty and the declared commitment to harmonize Ukrainian legislation in this area with European laws, Ukraine failed to implement principles of diversification of the electricity market. In 2011 and 2012, Rinat Akhmetov, Ukraine's richest man, added three billion US dollars to his net worth by buying state-owned energy assets sold by his political ally, President Viktor Yanukovych.<sup>37</sup> In September 2013, generation utility Donbassenergo, with two TPPs, was privatized and bought by Energoinvest Holding BV. This company was created in June 2013 by Igor Gumenuk, who is also associated with the business group headed by Rinat Akhmetov.<sup>38</sup>

In April 2015, the General Prosecutor's Office initiated court cases against DTEK and Energoinvest Holding, which could result in the deprivatization of Dneproenergo and Donbassenergo and their return to state control. Accusations stated that these assets were sold in violation of national laws (the Ukrainian constitution and laws titled «On the management of state property» and «On privatization of state property») and without competition to predetermined buyers.<sup>39</sup> The privatization of energy assets carried out by the State Property Fund under President Viktor Yanukovych was also questioned by business groups and oligarchs who were in opposition to Yanukovych.

<sup>37</sup> <http://www.businessweek.com/news/2012-05-02/richest-ukrainian-makes-3-billion-on-state-asset-sales>

<sup>38</sup> [http://www.ukrrudprom.ua/analytics/Donbassenergo\\_antimonopolnoe\\_dosledovanie.html](http://www.ukrrudprom.ua/analytics/Donbassenergo_antimonopolnoe_dosledovanie.html)

<sup>39</sup> Forbes UA: Subtract and multiply: re-privatization of power companies launched <http://forbes.ua/business/1392191-otnyat-i-umnozhit-reprivatizaciya-oblenego-startovala>

Despite these court cases, the government does not foresee nationalization of the energy sector and is in fact planning further privatization. Finance Minister Natalia Yaresko announced that the large-scale sale of state property would begin in 2015. The list of objects for sale, developed by the Cabinet of Ministers, contains 342 items, including shares of companies generating and supplying energy such as Centenergo (78%) and Donbassenergo (25%).

These two moves, denouncing the privatization of Dneproenergo and Donbassenergo and new sales of state assets in the energy sector, are now in conflict. In such turbulent conditions, the chances of coming out ahead in this re-distribution of assets largely depends on the political background of the players.

## 4.2 Industrialized illegal mining

In 2013, numerous reports<sup>40</sup> outlined the links between the Yanukovych regime and widespread corruption related to illegal coal mining and subsidization of the coal industry in Ukraine. The illegal mining was controlled through a state-wide network of corruption in the administrative apparatus and private companies such as Dutch-registered MAKO Holding B.V. and its Swiss subsidiary MAKO Trading S.A.<sup>41</sup> Journalistic investigations revealed the ex-president's eldest son Alexander Yanukovych as the owner and end beneficiary of MAKO Holding.<sup>42</sup> Multiple officials were involved in organizing schemes which allowed legalizing coal from copankas (makeshift illegal coal mines) with fake certificates from state-owned mines and burning it at state-owned power plants belonging to Centerenergo and Donbassenergo.



Copanka in the Donetsk region, courtesy Denis Kazansky,  
<http://frankensstein.livejournal.com/>

<sup>40</sup> <http://www.epravda.com.ua/rus/publications/519b0ab99fc5d/>

<sup>41</sup> <http://en.necu.org.ua/dutch-registered-company-is-involved-in-yanukovychs-coal-business/>

<sup>42</sup> <http://forbes.ua/news/1358471-syn-yanukovicha-dal-mako-holdingu-besprocentnyj-kredit>

Illegal coal mines, or copanky, have existed in Ukraine for more than two decades. They emerged as a spontaneous people's business, but eventually they were brought under control, at first by organized crime and afterwards by "businessmen" backed by officials. Under Yanukovich, illegal mining operations were centralized and turned into an extremely profitable industry. Millions of tons of coal coming from these operations were a resource basis for a state-wide fraud scheme, incorporating governmental officials at all levels – from local to highest.<sup>43</sup>



Illegal mining operations in Donetsk region. Source: National ecological centre of Ukraine

These activities caused unprecedented damage to the country's environment and economy. According to Mihailo Volynets, the head of Ukraine's Association of Independent Unions, in 2012 illegal mines produced around 10% of the total coal production in Ukraine<sup>44</sup> – more than 6.5 million tons – and in 2013, illegal mining continued to grow, exceeding 7 million tons.

In the same period, lobby organizations, such as European Association for Coal and Lignite (EURACOL), continued to champion Ukraine's disrupted coal sector as a developing industry that can produce quick and easy profits, thus promoting further investments in this corrupt black hole.

<sup>43</sup> Ukrainian Week: Digging for Billions. Who runs the illegal coal business in the Donbas. <http://ukrainianweek.com/Society/74747>

<sup>44</sup> BBC News: The coal-mining racket threatening Ukraine's economy <http://www.bbc.com/news/world-europe-22170976>

## 4.3 Electricity exports and associated emissions leakage

Paradoxically, a country faced with extreme energy shortages after supplies of coal from the Donbass region were disrupted is still exporting electricity to Europe. The western Ukrainian coal power plants – Dobrotvir and Burshtyn – are connected (in different ways) to the European grid and export approximately 55% of their electricity production to Hungary, Romania, Slovakia and Poland.

In 2011, after the privatization of Zakhidenergo, DTEK acquired control of these two coal-fired plants in western Ukraine and significantly increased their power output, switching on extra capacities for electricity exports. In October 2011, DTEK also started to export electricity to Poland using the Dobrotvir TPP – Zamosc interconnector line. In 2012, 1 TWh of electricity produced by the Dobrotvir TPP was exported to Poland, while exports from the Burshtyn Energy Island to the EU amounted to 3.8 TWh. That year, total electricity exports to the EU reached 4.8 TWh. In late 2012, the head of DTEK, Maxim Timchenko, said that his company “exported” about five million tons of coal through power lines.

Although EU businesses and households benefited from importing cheap coal-based energy from the Burstyn and Dobrotvir TPPs, it resulted in increased air pollution. CO<sub>2</sub> emission levels per kWh of electricity produced in Ukraine are higher than in the EU because of the plants’ low efficiency, while hazardous emissions are released practically unchecked because of the inadequacy of pollution control equipment. These power plants wouldn’t be allowed to operate in the European Union because of the levels of their SO<sub>2</sub>, NO<sub>x</sub> and dust emissions, which are higher than at the Varna TPP in Bulgaria, which was shut down on 1 January 2015 for incompliance with EU environmental regulations.<sup>45</sup>

### TOTAL ELECTRICITY EXPORTS

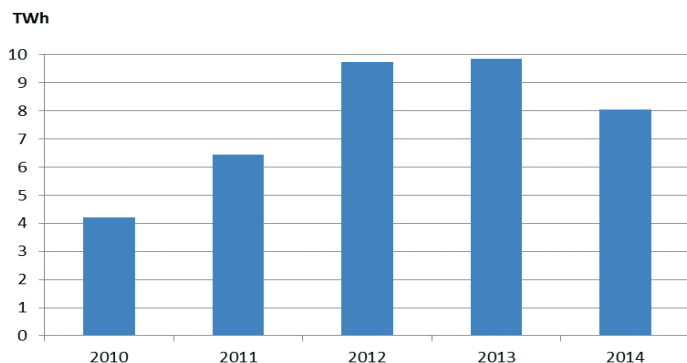


Figure 21: Total electricity exports. Data source: Ministry of Energy and Coal Industry

<sup>45</sup> <http://www.focus-fen.net/news/2015/01/01/358779/bulgarias-varna-tpp-closed-down.html>

In 2013, Ukraine exported 1.4 TWh to Moldova and 3.1 TWh to Belarus. While exports to Moldova and Belarus ceased in the fall of 2014, Ukraine remained a net exporter of electricity. Exports to Poland, which stopped in September 2014, resumed in July 2015. To cover the capacity deficit caused by anthracite shortages in the second half of 2014, Ukraine imported 178 GWh of electricity from Russia. If this practice continues in 2015, Ukraine might become a net importer of electricity in wintertime.

## ELECTRICITY EXPORTS IN 2013

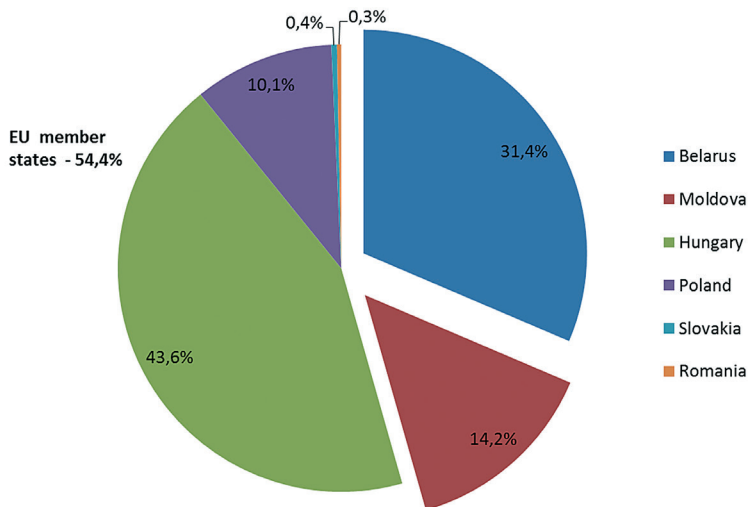


Figure 22: Electricity exports in 2013. Data source: National Energy Regulation Commission, Annual Report 2014

Continued exports of cheap coal-based electricity from western Ukraine contribute to business-as-usual scenarios in CEE countries, undermining the need for effective, controlled enhancements in energy efficiency and the deployment of renewable energy sources. At the moment, importing dirty coal-based electricity from Ukraine to other CEE countries still remains an attractive business.

#### 4.3.1. DOBROTVIR TPP



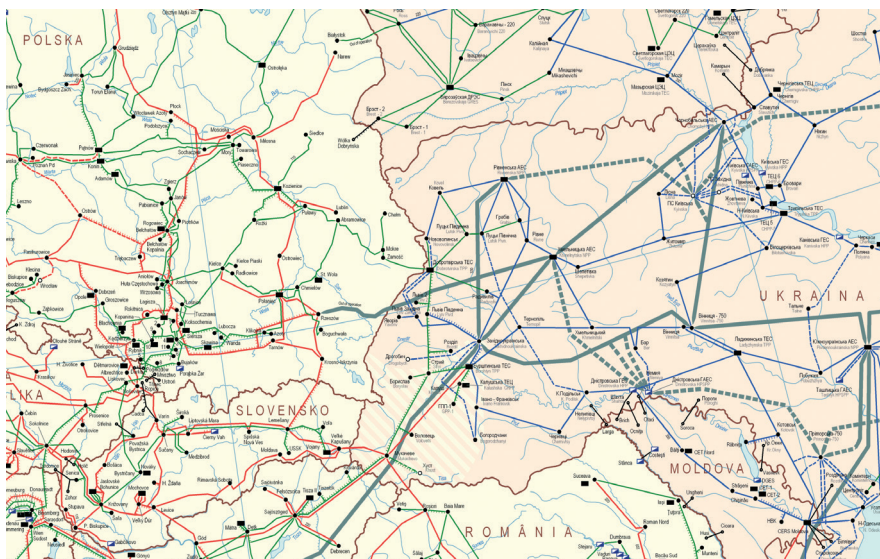
Pollution pours out of a chimney at the Dobrotvir TPP during startup operation

The Dobrotvir TPP is a 60-year-old plant situated in Lviv Oblast near the Polish border. Some of the boilers at the Dobrotvir TPP were commissioned as early as 1954. Along with significant wear on its boilers and other equipment, the plant is operating beyond its technically foreseen lifespan. Because of the plant's specific setup (parallel steam systems for all boilers and turbines), it can run with alternate use of five dilapidated boilers (which often need to be stopped for service operations) to power two turbines. Pollution control equipment is obsolete and inefficient, which in combination with frequent startup/shutdown operations results in high levels of hazardous emissions. Electricity is exported to Poland via a special interconnection line.

#### 4.3.2. BURSHTYN ENERGY ISLAND

One part of the Ukrainian power grid, which includes the Burshtyn TPP, is disconnected from the national grid and synchronized with the EU power grid ENTSO-E. The Burshtyn TPP is the only one that is in compliance with the EU grid's basic technical requirements. This part is called the Burshtyn Energy Island and covers the Transcarpathian region and big parts of the Lvivska and Ivano-Frankivska oblasts. Currently, DTEK exports energy to Hungary, Slovakia and Romania from this territory.





Burshtyn Energy Island on a map of the UCTE<sup>46</sup>  
(predecessor of ENTSO-E)

In 2002, the Burshtyn TPP and some of its auxiliary facilities (the 200 MW Kalushskaya combined heat and power plant and the 27 MW Tereble-Ritska hydropower plant) were disconnected from the Ukrainian power grid and attached to the UCTE (the predecessor of ENTSO-E), which allowed electricity to be exported to Europe.

The Burshtyn Energy Island is situated within the Transcarpathian, Ivano-Frankovsk and Lviv regions. Some of the power units at the Burstyn TPP, nominally rated at 2,300 MW, are not functioning. The active export transmission capacity from the Burstyn Energy Island currently amounts to 650 MW, while its total operational generating capacity is 1,950 MW.

## 4.4 Role of international private finance

In 2012, the planned construction of new coal-powered units and transmission lines in western Ukraine was publicly proclaimed by DTEK director general Maksim Timchenko as part of the overall DTEK strategy to «export coal via the power lines.» After the introduction of effective climate protection policies in the EU, however, the absence of such policies in Ukraine could result in a migration of highly carbon-intensive coal-based electricity production from EU member states to Ukraine.

European commercial banks, namely Deutsche Bank, UniCredit Bank, ING Bank, Raiffeisen Zentral Bank, Erste Group Bank, RBS and Barclays, have been involved in the coal industry

<sup>46</sup> Union for the Co-ordination of Transmission of Electricity, established in 1999

in Ukraine, most notably in the integrated coal and energy company DTEK.<sup>47</sup> The company's rapid growth between 2010 and 2013 was supported by these banks. In total, between 2005 and 2013, through loans and bond issues they provided more than 1.5 billion euros of credit finance for DTEK. Most of these funds were invested in coal mines and thermal power plants.

During Yanukovich's presidency, Akhmetov also acquired a 49-year concession for two large coal mining enterprises in Ukraine, Rovenkianthracite and Sverdlovanthracite, which provided a major share of anthracite supplies, both for domestic consumption and exports. In 2013, Deutsche Bank (together with Raiffeisen Bank, Erste Group, Uni Credit Austria and the Russian Gazprombank) granted a structured pre-export financing loan to DTEK, providing funds for export-oriented activities, including modernization of these two mines.<sup>48</sup>

In the winter of 2014-2015, after the outbreak of the conflict in Donbass, the Rovenkianthracite and Sverdlovanthracite mines, which are situated in the rebel-controlled part of the Lugansk region, operated between a quarter and a third of their capacity, being unable to distribute what they produced because of the destruction of railway infrastructure. In peacetime, they produced up to 40,000 tons of coal a day; in the fall of 2014, their output was reduced to just 8,000 tons. In general, military conflict has damaged a significant part of DTEK's mining assets in Donbass (with the Komsomelets Donbassa mine being practically non-recoverable), and a number of thermal power plants were severely damaged (Lugansk TPP and Mironivska TPP). In March 2015, DTEK posted a full-year net loss of 19 billion hryvnia (833 million US dollars) after a net profit of 3 billion hryvnia (161 million US dollars) in the previous year.

Instead of sustainable development, credit finance provided by EU banks has contributed to strengthening chains of inefficiency and corruption, which are now binding Ukraine's energy sector. Now, creditors are facing an uncertain situation with DTEK's coming default, which is considered imminent.<sup>49</sup>

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<sup>47</sup> See DTEK entry at [coalbanks.org](http://coalbanks.org)

<sup>48</sup> <http://www.scmholding.com/en/media-centre/news/view/1379/>

<sup>49</sup> "Fitch downgrades DTEK ratings, citing imminent default danger" <http://www.ukrainianjournal.com/index.php?w=article&id=20240>



# 5. The real cost of coal

## 5.1 Air pollution and health impacts

Ukrainian thermal power plants now demonstrate the lowest levels of technical, economic and environmental performance in Europe. The sector is responsible for 80% of total sulfur dioxide emissions in Ukraine and 25% of the country's nitrogen oxide emissions. Levels of hazardous emissions at Ukrainian TPPs exceed EU standards by 5 to 30 times and often exceed national emission restrictions. At many TPPs, dust emissions are as much as 45 times higher than EU emission limits. Dust-collecting devices, commissioned 25 to 50 years ago, are the only pollution control equipment in operation at most Ukrainian thermal power plants. Purification of sulfur and nitrogen oxides from flue gases is practically absent at Ukrainian TPPs.<sup>50</sup>

Long-term exposure to air pollution from fine particulates (PM<sub>2.5</sub>), which include sulfates and nitrates, is known to be the most harmful for human health. Levels of PM<sub>10</sub> and PM<sub>2.5</sub> are not monitored on a reliable basis in Ukraine. Existing assessments of the health impacts of particulate matter pollution are based on total suspended particles (TSP) data, factored into PM<sub>10</sub> or PM<sub>2.5</sub>.

Economic damage related to the mortality risk attributed to air pollution was estimated at about 4% of GDP. In total, air pollution-related mortality represents about 6% of total mortality in Ukraine. Pollution-attributed deaths in Ukraine were estimated to be in the range of 22,000 to 27,000 annually.<sup>51</sup> Air pollution levels are highest in southeastern Ukraine, where most of the power plants and steel mills are located. About 50% of all health effects are observed in Donetsk, Kriviy Rog, Zaporizhzhya, Makiyevka, Dnepropetrovsk and Odesa, whereas only 34% (as of 2006) of the urban population live in those cities.

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**50** Bankwatch: "Dusting off Ukraine's energy sector: Why the country must address inefficiency and pollution at its ageing coal-fired power plants" <http://bankwatch.org/publications/dusting-ukraines-energy-sector-why-country-must-address-inefficiency-and-pollution-its->

**51** Elena Strukova, Alexander Golub and Anil Markandya "Air Pollution Costs in Ukraine" [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=932511](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=932511)

# AGE-STANDARDIZED CARDIOVASCULAR DEATH RATES

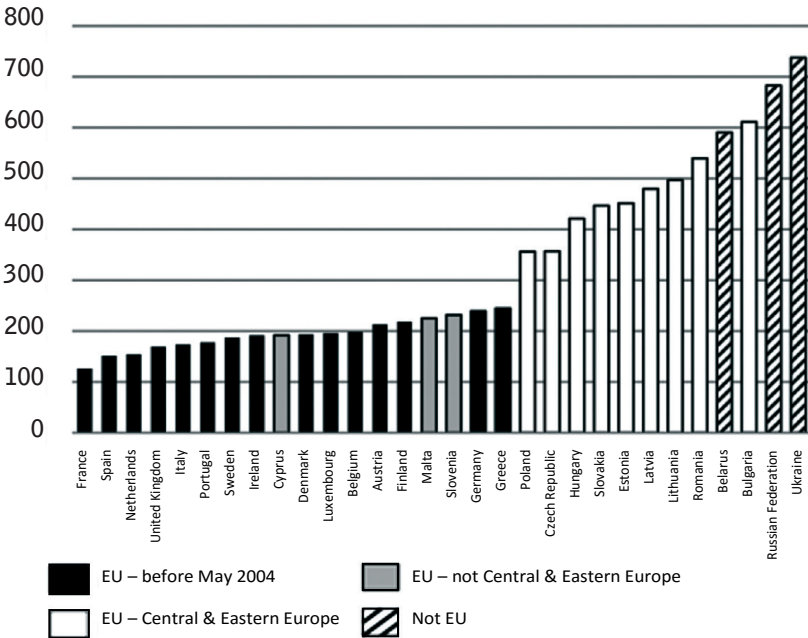


Figure 23: Age-standardized cardiovascular death rates (per 100,000) in the European Union (27 countries) and three non-EU Eastern European countries. Source: Public Health Reviews, Vol. 33, No 2, 416-435: “Cardiovascular Disease in Central and East Europe”

Recent research performed at Sumy State University found that air pollution is responsible on average for 10.3% of all incidents of cardiovascular diseases treated in outpatient clinics, 11% of digestion morbidity cases, 16% of respiratory morbidity cases and 30% and 10.5% of lung cancer in men and women, respectively.<sup>52</sup>

The unprecedented decline in lifetime expectancy, especially among men, was popularly attributed largely to social collapse and the ensuing increase in alcohol consumption and a lack of personal care. Contrary to popular views, research on air pollution-related mortality has shown that it is a very important component of overall mortality, causing more deaths than transport accidents and suicides.

<sup>52</sup> Economics Education and Research Consortium “Influence of environmental health: economic estimations for Ukraine” [http://eercnetwork.com/default/download/creator/working\\_papers/file/1ea178b26bdd8bad5a036d-8798c3ea75d618d373.pdf](http://eercnetwork.com/default/download/creator/working_papers/file/1ea178b26bdd8bad5a036d-8798c3ea75d618d373.pdf)

## LIFETIME EXPECTANCY AT BIRTH IN UKRAINE, YEARS

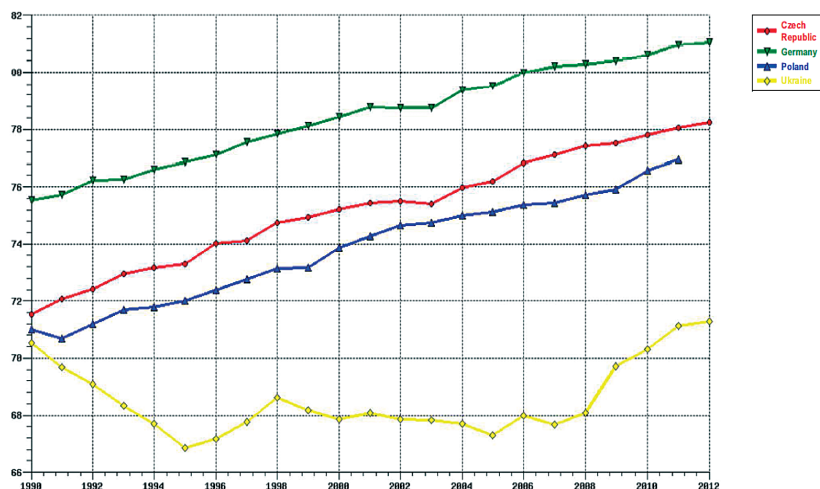


Figure 24: Lifetime expectancy at birth in Ukraine, compared to coal-intensive EU countries. Source: WHO Europe, European HFA Database, April 2014

Along with severe impacts on health and increased mortality, air pollution in Ukraine also causes losses in agriculture and forestry through soil acidification. In general, patterns of air pollution with sulfur dioxide and nitrous oxide in Ukraine and its implications for ecosystems are not sufficiently studied. According to data collected by the Coal Energy Technology Institute, annual emissions of sulfur dioxide from coal-fired plants in Ukraine exceed one million tons.<sup>53</sup>

## 5.2 Employment and safety of mining operations

In 1991, the industry provided jobs for about 870,000 people, with 511,000 people working directly in coal mining. By 2003, the number of jobs had dropped to 230,000 and 160,000, respectively. Many of the industries connected with mining were hard-hit by the fall of the Soviet Union, causing widespread unemployment.

Since 2006, after a partial revival of coal industry, employment in this sector has slightly increased. According to Euracoal data, in 2013 273,820 people were employed in Ukraine's official (legal) coal mining industry. Total employment in the coal industry (mining, processing, thermal power) was around 450,000 people, with most of the jobs (more than 90%) in the now war-torn Donbass region.

<sup>53</sup> Coal Energy Technology Institute "Prospects for the implementation of clean coal technologies in the energy sector of Ukraine", p. 157 <http://www.cetipproject.com/PICCTESUbook.pdf>

Although average labor efficiency since 1991 has increased significantly in privatized mines, the state-owned mines have seen little progress. Coal mining productivity in Ukraine is much lower than the global average. For example, average labor efficiency is twice as high in Poland, five times as high in Western Europe and even 20 times as high in the USA.

Complicated mining conditions, outdated equipment and poor labor safety conditions (especially at state-owned mines) have resulted in extremely high accident and injury rates in Ukraine's coal mining. In total, according to the State Committee for Industrial Safety, the coal sector is the most dangerous industrial sector, accounting for 15.6% of total fatal accidents in all industrial sectors. That is, every sixth person who has died in an industrial accident was a miner. According to the State Service of Mining Supervision and Industrial Safety, 2,034 miners were injured and 99 died in 2014.<sup>54</sup>

The coal mines of Donbass are some of the most hazardous in the world because of the mines' significant depths, as well as frequent methane explosions, coal dust explosions, rock burst dangers and outdated infrastructure. According to official data, every million tons of coal extracted in Ukraine takes four miners' lives, while the figure in Europe amounts to 1 person per 100 million tons of coal. Since 1991, there have been 38 major accidents – several every year, each killing dozens of miners. Mortality in state-owned mines is much higher than in private ones, which are better equipped and have higher safety standards. The heaviest death toll is at the state-owned Zasyadko mine near the city of Donetsk, which has taken hundreds of lives. The biggest mining accident in Ukraine occurred at this mine in 2007, when a methane explosion underground killed 101 miners. The most recent accident occurred there on 3 March 2015, killing 34 people.<sup>55</sup>

As for illegal mining, which is widespread in the Donbass region, occupational safety rules are practically nonexistent. Most accidents associated with illegal mining are not being reported, thus it is hard to estimate associated mortality rates. If these were taken into account, Ukraine's record could increase further. In rebel-controlled territories, make-shift mining operations and unsafe jobs with no benefits or recourse to legal and other help are growing, while employment at official mines is decreasing.

## 5.3 Socio-economic situation in coal-mining regions

The disappearance of the Donbass region's relative affluence (Soviet miners were portrayed as role models and enjoyed privileges not available to the average Soviet laborer) came as a shock to the miners and those who depended on them, and living standards in the region fell dramatically. By 1993, industrial production had collapsed, and average wages had fallen by 80% in three years. Since the mid-1990s, economic diversification hasn't occurred, and people there remain highly dependent

<sup>54</sup> <http://dnop.gov.ua/index.php/uk/pres-sluzhba/vsi-novini/10918-u-2014-rotsi-na-vugilnikh-shakhtakh-zag-inulo-99-girnikiv-z-nikh-13-vnaslidok-vedennya-bojovikh-dij?month=1&year=2015>

<sup>55</sup> <http://www.pravda.com.ua/news/2015/03/6/7060732/>

on the coal industry. Consequent social deterioration, high unemployment rates and poverty caused an increase in crime, drug addiction and HIV rates.

This is particularly so for small towns and villages, where most people worked at coal mining companies. The Soviet practice of establishing single-industry cities and villages resulted in significant social problems when many mines were shut down in the 1990s, leaving many people without jobs or alternative options for legal employment. Starting in the mid-1990s, Donbass became a highly criminalized area, and eventually the economy of the region fell under the control of former organized crime leaders who have legalized their acquisitions and become oligarchs.

In the regions of Lviv and Volyn, employment in coal mining also decreased significantly, but the populations' higher mobility and the relatively small share of the mining sector in the local economies mean that the impact of its breakdown in the 1990s was not as severe as in Donbass.



Photo by Vladimir Lapshyn

## 5.4 Ruined environment

Poor governance in the highly industrialized southeast of Ukraine (especially in Donbass) has led to progressive deterioration of the local environment, resulting in chronic problems such as water supply disruptions, increased salinity of groundwater, accumulation of enormous amounts of solid waste, resulting land degradation, air pollution with dust particles and mudslides from spoil tips.





The remains of a forest flooded by mine waters.  
Photo by Vladimir Lapshyn

Most of the mines in both Ukraine and Russia were simply abandoned without any remediation measures, which in the mid-1990s led to widespread water outflows from the abandoned mines and, in turn, floods in Donbass and the neighboring Rostov region in Russia, where more than 100 mines were closed down.

A typical example is the town of Bryanka in Lugansk. The development of coal mining resulted in the dewatering of underground aquifers in the land, which was previously swampy. Settlements were established on the drained land and agriculture was introduced. New hydrogeological conditions were maintained thanks only to the ongoing dewatering of mines with powerful pumps. In the 1990s, six of Bryanka's eight mines were closed. In 2001, the Krasnopilska mine, one of Bryanka's two remaining mines, was closed. Ceasing de-watering operations resulted in subsidence, which has damaged the town's buildings and communication facilities, and large areas of land were flooded.



Slagheaps near Horlivka city.  
Photo by Vladimir Lapshyn

Now that the region is torn by ongoing war, environmental problems which had been accumulating for decades have multiplied. Flooding in the mines, which are being abandoned, can have unpredictable outcomes. The Donets coal basin is an enormous geological system that was significantly transformed by mining activities, forming complex artificial structures, where most mines that can reach one kilometer in depth are aerodynamically and hydraulically connected and affect the watershed of the Siversky Donets River. One unusual threat is the result of an industrial accident that occurred in 1989 at the chemical plant in Horlivka, where 35 tons of nitrochlorobenzene entered the Olexandr-Zakhid mine, situated directly under the plant site.<sup>56</sup> Both the plant and the mine are now abandoned. If the mine is flooded, this highly toxic compound can migrate to the surface and contaminate groundwater. Along with the plant in Horlivka, a number of other chemical waste disposal sites in Donbass have not been maintained, and there is a risk of toxic leakages.

<sup>56</sup> MiningWiki.ru: Accident at Alexander-West coal mine <http://bit.ly/1hfC7AT>

## 5.5 The tragedy of Donbass: from illegal mining to a resource war

A failure to conduct an effective re-structuring of the coal industry, under-regulation and widespread corruption already resulted in overall socio-economic deterioration in Donbass. Under the Yanukovych regime, which took total control over the region, the situation became catastrophic.

When illegal mining was scaled up to industrial operations, it became a threat to the privatized mining industry, sparking a conflict between Yanukovych and Rinat Akhmetov, whose interests in the coal sector were threatened. In April 2013, on condition of anonymity, a source close to Akhmetov's mining company DTEK confirmed to reporters of BBC News that the company was deeply concerned about illegal mining.<sup>57</sup> Later that year, the gap between Akhmetov and Yanukovych deepened, and when the Euromaidan protest broke out, Akhmetov positioned himself as a pro-European advocate and called for negotiations with protesters.<sup>58</sup> In political terms, this meant a split inside the ruling Party of Regions, with Akhmetov's faction ready to support the removal of Yanukovych. By December 2013, a ruling Donbass clan was thus experiencing external and internal pressures that led to the end of their reign in Ukraine.

In early 2014, the Party of Regions and associated groups remained a dominant force in the Donbass region during the revolutionary events in Ukraine and had successfully crushed pro-European protests and encouraged pro-Russian movements. After the fall of the regime and the hasty retreat of Yanukovych and his entourage to Russia, however, the former rulers of Donbass lost control over the situation in the region, which was overtaken by pro-Russian rebels.

In March 2013, Russia started to act decisively and fast in pursuit of its resource interests, deploying military troops in Crimea and taking political control of the Donbass region in an effort to overrun the revolutionary movement in Ukraine. After the annexation of Crimea (with its oil and deposits in the Black Sea shelf), demonstrations by pro-Russian groups in Donbass escalated into an armed conflict between the separatist forces of the self-declared Donetsk and Lugansk People's Republics and the Ukrainian government. In August, Russian military vehicles crossed the border in several locations of Donetsk Oblast, amassing 40,000 army units near the Ukrainian border. Since summer 2014, the conflict has escalated to full-scale military operations with use of heavy arms.

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57 BBC News: The coal-mining racket threatening Ukraine's economy <http://www.bbc.com/news/world-europe-22170976>

58 Korrespondent: Akhmetov supports Euromaidan and urges parties to the conflict to the negotiating table <http://korrespondent.net/business/economics/3276964-akhmetov-podderzhal-evromaidan-y-pryzval-storony-konflykta-sest-za-stol-perehovorov>



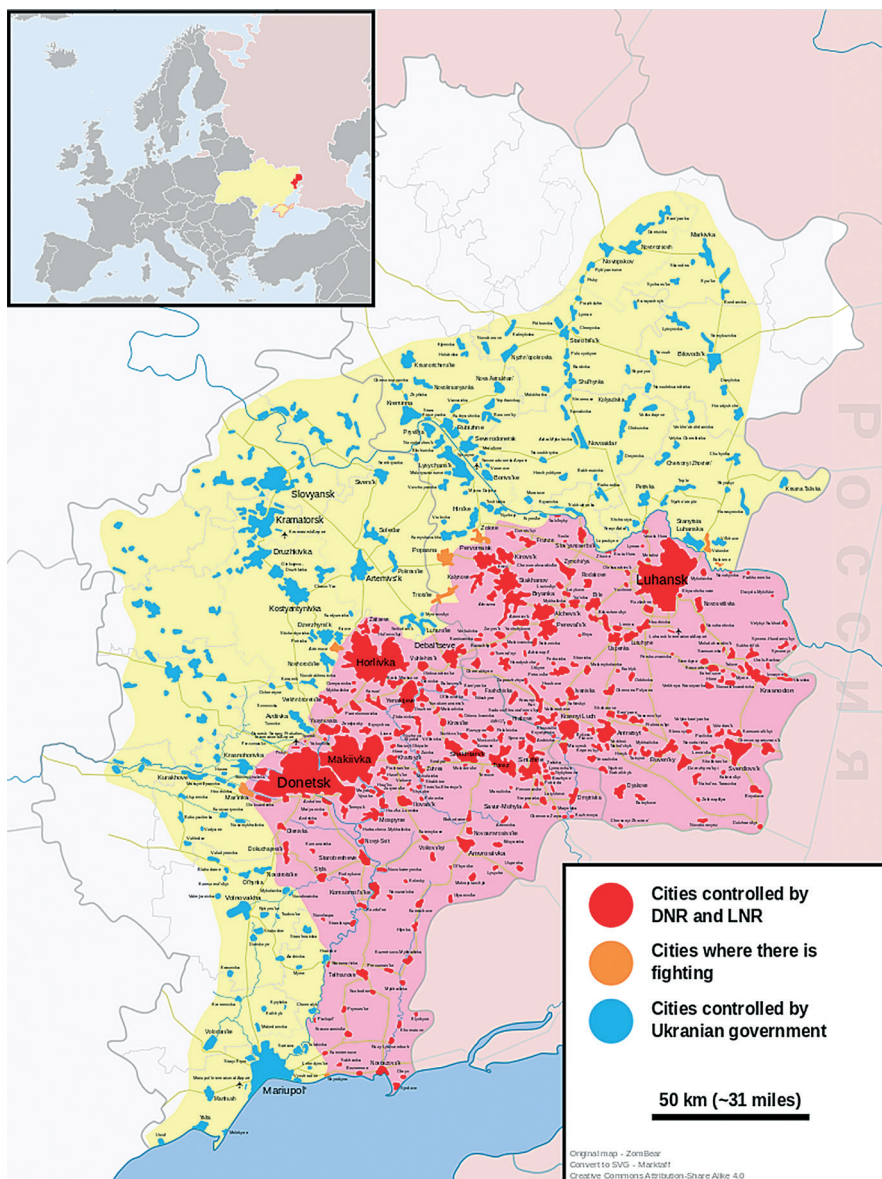


Figure 24: Map of occupied territories in Donbass. Pink areas and red cities were held by DPR/LPR insurgents as of February 2015. Yellow areas and blue cities were previously held by insurgents but retaken by the Ukrainian government. Orange settlements were contested. Source: Wikimedia Commons. CC BY-SA 4.0 [https://en.wikipedia.org/wiki/War\\_in\\_Donbass#/media/File:Map\\_of\\_the\\_war\\_in\\_Donbass.svg](https://en.wikipedia.org/wiki/War_in_Donbass#/media/File:Map_of_the_war_in_Donbass.svg)

On 11 May 2014, the separatist republics held internationally unrecognized referendums on the status of the Donetsk and Luhansk oblasts. These referendums, viewed as illegal by Ukraine and undemocratic by the international community, returned a result in favor of autonomy from Ukraine. Fighting continued through 2014 and into 2015, despite several attempts at implementing a ceasefire.

Coal mining was severely impacted by military operations, with some of the mines being hit by shelling and others experiencing cut-offs of power supplies. Most of the coal mines (and all anthracite-producing ones) ended up in the territory under terrorist control, and in the fall of 2014, militants blocked the delivery of coal to power plants in Ukraine-controlled territory. In addition, the Organization for Security and Co-operation in Europe reported Russia sending coal to its territory using smuggling channels.<sup>59</sup> While official mines are being shut down and even vandalized, Illegal mining is on the rise and is controlled by the region's new pro-Russian rulers.<sup>60</sup>

The war has created shortages in the coal supply to Ukraine's mainland thermal power plants, especially for those which were running on anthracite. In order to cover the shortage, the government was forced to look for coal abroad. As a result, Ukraine has increased its dependence on Russia, which supplied 64.19% of total coal imports to Ukraine in 2014, equaling 1.138 billion US dollars. Moreover, Russia effectively manipulated its "energy monopoly" position by partially suspending coal exports to Ukraine in January 2015.<sup>61</sup> Ongoing war with Russia has a clear "energy racket" component, with coal and gas supplies being used for political blackmail.



Ruins of the Donetsk International Airport, December 2014. Source: Wikimedia Commons. CC BY 3.0 [https://en.wikipedia.org/wiki/Donetsk\\_International\\_Airport#/media/File:Ruins\\_of\\_Donetsk\\_International\\_airport\\_%2816%29.jpg](https://en.wikipedia.org/wiki/Donetsk_International_Airport#/media/File:Ruins_of_Donetsk_International_airport_%2816%29.jpg)

<sup>59</sup> OSCE continues to record the facts export coal from the Donbass occupied Russia <http://www.unian.ua/war/1098131-obse-prodovjue-fiksuvati-fakti-vivezennya-vugillya-z-okupovanogo-donbasu-do-rosiji.html>

<sup>60</sup> Militants destroy mines of Donbass, Russian managers advise them [http://www.ukrinform.ua/ukr/news/boyoviki\\_znishchuyut\\_shahti\\_donbasu\\_zaporadami\\_rosijskih\\_menedzeriv\\_1984224](http://www.ukrinform.ua/ukr/news/boyoviki_znishchuyut_shahti_donbasu_zaporadami_rosijskih_menedzeriv_1984224)

<sup>61</sup> O. Pavlenko et al. "War in energy sector as a second front" Collection of writings by the Centre for East European Policy Studies, University of Turkey. [http://ua-energy.org/upload/files/War\\_in\\_Ukraine\\_2015.pdf](http://ua-energy.org/upload/files/War_in_Ukraine_2015.pdf)



Photo by Vladimir Lapshyn

In November 2014, it was reported that the number of people that had fled insurgent-held areas of Donbass had reached 1.5 million. About half of these fled to Russia, and the other half fled to peaceful parts of Ukraine. As such, the population of insurgent-held Donbass had decreased by a third from its pre-war level. Those forced to stay in the region were largely elderly, destitute, or otherwise unable to flee. Schools saw significantly fewer students, as roughly half of the pre-war population of school-age children had left Donbass.<sup>62</sup> The infrastructure of the region is deteriorating progressively because of the continued use of heavy arms in conflict border zones and the looting of metals and copper wiring inside rebel-controlled territories. Additional property damage in Donetsk and Lugansk People's Republics is being caused by expropriation and vandalism by local militias.

The short-lived fame of Donetsk as a city of riches is vanishing. The lesson the world should learn from Ukraine is that unregulated exploitation of fossil fuels and privatization of energy-intensive industries leads nowhere but to complete social, economic and environmental collapse.

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<sup>62</sup> "Nowhere to Run in Eastern Ukraine". The New York Times. 13 November 2014. [http://www.nytimes.com/2014/11/14/world/europe/nowhere-to-run-in-eastern-ukraine.html?\\_r=0](http://www.nytimes.com/2014/11/14/world/europe/nowhere-to-run-in-eastern-ukraine.html?_r=0)







## 6. Conclusions

In light of its critical dependence on energy imports from Russia, the collapse of the coal industry in Donbass and the poor condition of the country's economy, Ukraine has little choice but to decrease its energy consumption, primarily of coal and gas. The necessity and potential to address energy efficiency and reduce energy consumption are enormous and more urgent than ever.

In the coming years, Ukraine's energy sector needs to be fundamentally reorganized, which can be achieved with the de-monopolization of energy services, an immediate decrease in coal mining and thermal power generation followed by development of a long-term exit strategy from coal as an energy source, an end to cross-subsidies and promotion of transparent energy pricing instead, ensuring priority grid access for renewables and the introduction of incentives for energy conservation (such as white certificates for utilities and time-bound pricing for consumers). For this to be achieved, Ukraine needs to build its energy policy on the rule of law, transparency and sustainable development instead of service for private interests. Most of these changes can be introduced by adopting and effectively enforcing a new national legislation package for the implementation of the Energy Community acquis communautaire.

Monopolization remains one of the biggest obstacles for sustainable change in the energy sector. To solve this problem, Ukraine needs to re-structure and split its vertically integrated companies, both private and state-owned, and ensure access for new players and a fair competitive environment. Along with structural reform, a politically independent and professional energy regulatory authority must be established.

Ukraine's massive, highly centralized and highly dysfunctional electric power system needs to be effectively re-structured to create space for future deployment of new, efficient infrastructure based on renewable energy sources, smart grids and electricity storage. The status and performance of each thermal power plant needs to be carefully assessed to develop a comprehensive plan for re-structuring Ukraine's thermal power sector in preparation for a gradual phase-out of all existing coal power plants by 2050. The

government should provide incentives for operators to phase out the most polluting units as soon as possible and create security for investments in filter upgrades for those TPPs that are projected to operate longer than ten years to eliminate hazardous air pollution and reduce negative health impacts.

Along with a gradual phase-out of centralized capacities (both coal and nuclear) by mid-century, de-centralization of electric infrastructure and a transition to a lateral mode of grid operation must also occur, enabling free exchange of energy between a large number of producers and consumers of electricity. Instead of replacing old centralized capacities with new ones, a shift to a new type of energy infrastructure is needed, which will allow a transition to a low-carbon economy, helping Ukraine make an effective contribution to global efforts to mitigate climate change.

After the introduction of high-priority energy efficiency policies and energy market reform, Ukraine needs to develop a well-crafted long-term development strategy and vision, which would encompass a new energy paradigm and transition plan to renewable energy and de-centralized smart grid infrastructure.

The roadmap for such a transition – the Third Industrial Revolution vision<sup>63</sup> as developed by economist Jeremy Rifkin – already exists and has already started being implemented in many parts of the world, most actively in the European Union. To recover its economy and transform its currently dysfunctional energy sector, Ukraine needs to jump on the EU's energy transition train, effectively use the policy reform toolbox provided by the Energy Community and contribute to the transformation of energy infrastructure in Europe.

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**63** <http://thethirdindustrialrevolution.com/>

# ANNEXES

## Annex I

### LIST OF THERMAL POWER PLANTS OF 5 MAJOR POWER GENERATION COMPANIES

TPP name	Number of units and their project capacity, MW and fuel type	Date of commissioning (I and II courses)	Number of units and their actual capacity in 2012, MW	Number of units on/off in 2012	Status updates
<b>DTEK Dniproenergo</b>					
Prydniprovsk'a	4x150 + 4x300 anthracite	1958-1965	3x285 + 4x150 + 1x310	8 / 2	fuel shortages as of July 2015
Kryvoriz'ka	10x300 anthracite	1965-1973	10x282	10 / 2	fuel shortages as of July 2015
Zaporiz'ka	4x300 / 3x800* hard coal / gas	1972-1979	4x300 + 3x800*	7 / 4	Unit #3 launched after reconstruction – Nov. 2014
<b>DTEK Shidenergo</b>					
Kurakhivska	1x200 + 6x210 hard coal	1971-1975	1x200 + 3x210 + 1x222 + 2x225	7 / 1	
Zuivska	4x300 hard coal	1982-1988	1x325 + 1x320 + 2x300	4 / 1	
Lugansk	8x200 anthracite	1961-1969	3x175 + 4x200	7 / 1	Damaged by shelling in 2014
<b>DTEK Zahidenergo</b>					
Ladyzin	6x300 hard coal	1970-1971	6x300	6	
Dobrotvir	2x150 + 3x100 hard coal	1953-1954, 1963-1964	1x150 + 1x160	2**	Apr. 2014 – one turbine modernized, power output increased to 160 MW  <a href="http://www.turboatom.com.ua/press/news/2857.html">http://www.turboatom.com.ua/press/news/2857.html</a>
Burshtyn	12x200 hard coal	1965-1969	3x185 + 8x195 + 1x206	12 / 2	
<b>DTEK Donetskoblenenergo</b>					
Myronivska	1x100 + 1x60	1953	1x115	1	Seized operations in January 2015, not operational
<b>Donbasenergo</b>					
Starobeshivska	10x200 anthracite	1961-1967	5x175 + 3x200 + 1x210 + 1x215	10 / 2	Located in rebel-controlled territory
Slovianska	2x100 + 1x800 + 1x800* anthracite	1953-1954, 1967-1971	1x800	1	Damaged by shelling in 2014

Centerenergo					
Vyhlegirsk	4x300 / 3x800* hard coal / gas	1972-1977	4x300 + 3x800*	7 / 3	Coal units damaged by major fire in 2013, only 2 units restored
Zmiivska	6x200 + 4x300 anthracite	1960-1969	6x175 + 3x275+ 1x325	10	fuel shortages as of July 2015
Trypil'ska	4x300 / 3x300* anthracite / gas	1969-1972	4x300 + 2x300*	6 / 2	May 2014 – coal unit #2 launched after full reconstruction, power increased to 325 MW
Total	29 320 / 23 020***	Average age 45-50 years	27 178 / 21 778***	97 + 2** / 21	

\* Units designed for natural gas or heavy oil firing (5,4 GW total untapped capacity)

\*\* Dobrotvir TPP is operating with 5 boilers powering 2 turbines

\*\*\* capacity of coal-fired units

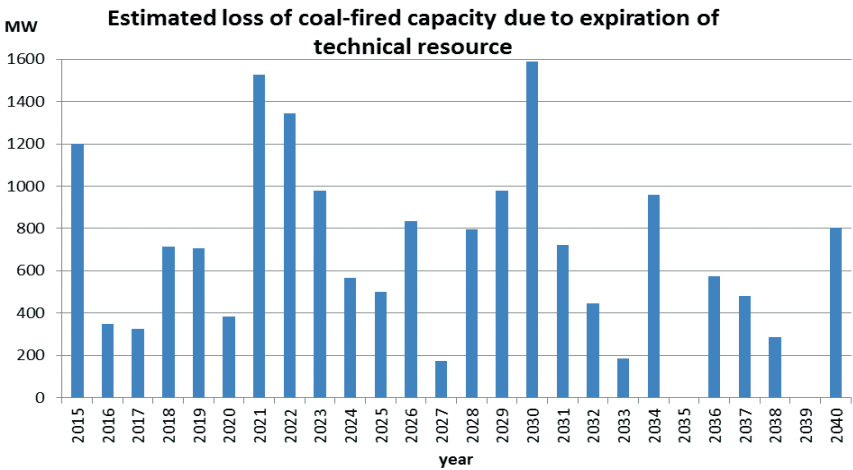
Data source: Coal Energy Technology Institute of National Academy of Sciences of Ukraine



**PROJECTED LIFESPAN OF EXISTING TPPS OF MAJOR POWER GENERATION COMPANIES**

Projections are made using available data for operational hours reached by coal-fired units of TPPs in 2012 and their respective load factors. Modeling included two suggestions:

- 1) average load factors of units remains close to values of 2012;
- 2) after reaching 320 000 hours in operation (marginal technical resource/metal age limit) unit is being switched off and decommissioned.



**CUMULATIVE CAPACITY LOSS DUE TO EXPIRATION OF TECHNICAL RESOURCE**

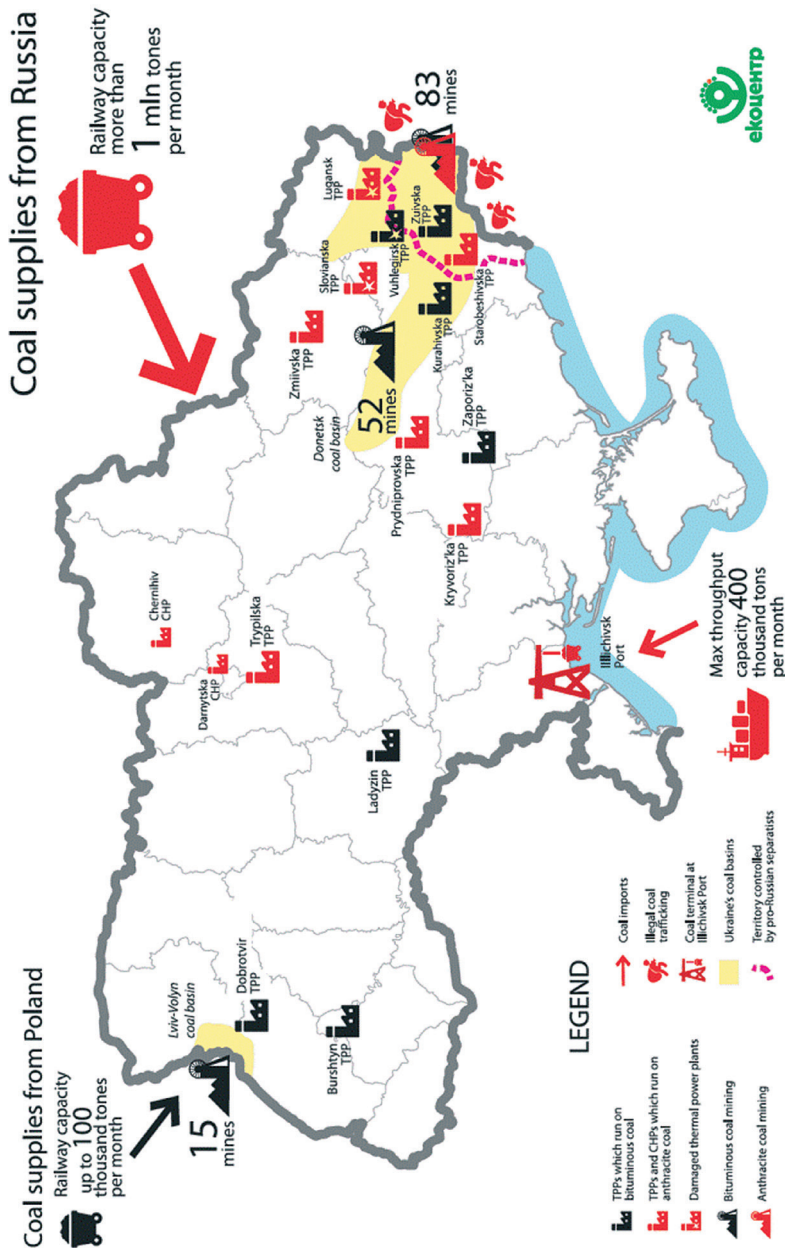
Year	2015	2018	2023	2027	2030	2034
MW	1200	2589	7531	9606	12966	15278

**EXISTING CAPACITIES WHICH HAVE OPERATIONAL POTENTIAL AFTER 2040:**

coal-fired	4431 MW
gas-fired	5400 MW

Source of input data: "Prospects for the implementation of clean coal technologies in the energy sector of Ukraine"/[Igor Volchyn, Nataliya Dunayevska, Liudmyla Haponych, Mykola Chernyavskiy, Alexander Topal, Yaroslav Zasyadko]. – K.: HNOZIS, 2013. - 310 p.

INFOGRAPHIC MAP. IMPACT OF CONFLICT IN DONBASS ON COAL INDUSTRY



Source: CC-BY-NC-ND 2015 National Ecological Centre of Ukraine, [www.necu.org.ua](http://www.necu.org.ua)

## LIST OF FIGURES

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<https://www.iea.org/newsroomandevents/graphics/2014-07-08-energy-intensity-in-ukraine-and-russia-.html>
- 2.** Primary energy consumption in Ukraine 2013. Data source: State Statistical Service  
[http://ukrstat.org/uk/operativ/operativ2014/energ/en\\_bal/Bal\\_2013\\_u.zip](http://ukrstat.org/uk/operativ/operativ2014/energ/en_bal/Bal_2013_u.zip)
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[http://www.menr.gov.ua/docs/klimatychna-polityka/doclad\(En\).pdf](http://www.menr.gov.ua/docs/klimatychna-polityka/doclad(En).pdf)
- 8.** Carbon dioxide emissions per unit of GDP in Ukraine, Poland, the Netherlands and Turkey. Source: International energy statistics database of U.S. Energy Information administration  
<http://www.eia.gov/beta/international/data/browser/>
- 9.** Share of coal in CO<sub>2</sub> emissions. Data sources: National Greenhouse Gases Emission Inventory for 2013 [http://www.menr.gov.ua/docs/klimatychna-polityka/doclad\(En\).pdf](http://www.menr.gov.ua/docs/klimatychna-polityka/doclad(En).pdf), IEA <https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2014.pdf>
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