SELECTED HIGH-IMPACT MEASURES

A socially sustainable coal phase-out in Ukraine

by Dr. Georg Zachmann, Anna Temel, Manuel von Mettenheim

Low Carbon Ukraine

Implemented by
Berlin Economics

Supported by:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
based on a decision of the German Bundestag

Motivation and project background

This policy proposal is part of a series which was elaborated in the framework of the project Low Carbon Ukraine (LCU) supporting more ambitious paths for selected energy and climate policy areas.

The idea to develop the present ten "Policy Proposals" arose in the course of LCU's support for the Ministry of Energy of Ukraine in setting up a National Energy and Climate Plan for Ukraine. While Ukraine's climate targets are partially very ambitious, we often observed a lack of underlying analysis and concrete policy measures to achieve those targets. For the most crucial topics, we provide a comprehensive analysis and propose concrete policy measures based on international experience.

Each Policy Proposal was written in a multi-stage process: a first draft of LCU experts or invited professionals was discussed over summer and early autumn 2020 with Ukrainian experts and stakeholders. Results of those discussions were taken into account when updating the Policy Proposals. It is important to note, that the presented results reflect the view of the authors and not necessarily the position of the BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety).

We hope that the present analysis and proposals will contribute to a fruitful and constructive discussion and help Ukraine to develop ambitious, yet realistic energy and climate policies.

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Low Carbon Ukraine is a project with the mission to continuously support the Ukrainian government with demand-driven analysis and policy proposals to promote the transition towards a low-carbon economy. It is part of the International Climate Initiative (IKI) and is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the basis of a decision adopted by the German Bundestag. The project is implemented by BE Berlin Economics GmbH.

ACKNOWLEDGEMENT

The authors thank all participants in our stakeholder and expert workshops in August 2020 for their critical reflections and helpful comments. A special thank goes to Mr. Roman Mendelevitch who conducted an external review of this paper. We also thank Dmytro Naumenko for extremely helpful analysis and quantitative contributions.

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Executive Summary

Despite its continuously decline in the past 30 years, Ukrainian hard coal production still plays a salient role in Ukraine's economy. On the demand side, thermal power plants which are fueled with coal, still generate 31% of Ukrainian electricity. However, to comply with its climate obligations, a coal phase-out is an inevitable step for Ukraine on its decarbonization path. Economic reasons will also push coal out of the market as an energy source. This is due to the decreasing profitability of coal mines in Ukraine, which will be further reduced by the implementation of the National Emission Reduction Plan, a potential move away from coal subsidies and a presumed increase of the carbon tax.

This paper proposes accompanying measures for the coal phase-out, aimed at dampening its negative impact on the development of affected regions and their labour market. The measures proposed include direct measures addressing former miners, such as retraining programs, but also broader instruments like the set-up of a just transition fund and the creation of new regional development agencies. If successfully implemented, a politically accompanied structural change offers the opportunity to bring about an economic shift towards a more future-oriented industrial landscape and to overcome the socio-economic challenges that coal mining areas are facing today. A phase-out of subsidies can accelerate the process and carry some costs of this change.

Overview of the coal sector

I. Coal mining

Ukraine has abundant deposits of hard coal in the Lviv-Volyn and the Donetsk basins.

Ukraine has large coal reserves with hard coal accounting for the largest share at 32 Gt making it the 6th largest reserves in the world (BGR, 2020). Hard coal deposits are concentrated mainly in the Lviv-Volyn and the Donetsk basins (Figure 1). In the latter, up to 90% of the country's hard coal deposits are located comprising the oblasts Donetsk, Lugansk and Dnipropetrovsk (larger area of the Donbas) (ILO, 2018). Hard coal mining operations take place at 500 to 1,000 metres by thin seams of 0.8 to 1.0 metre. In fact, Ukraine also has abundant lignite deposits (2.3 Gt) which are located in the Dnieper basin. However, Ukrainian lignite production is negligibly small.

Figure 1: Ukraine's coal deposits

Source: Ogarenko (2010)

The country suffers from an unproductive coal mining sector with state mines in particular generating losses.

After the collapse of the Soviet Union, Ukraine inherited an unproductive coal sector with low-quality coal that had a high sulphur content (Amosha *et al.*, 2017). In 1991, there were around 280 coal mines in Ukraine. Following the economic liberalisation path in the 1990s, production of Ukrainian mines dropped sharply (Dudău *et al.*, 2019). Between 2000 and 2005, a bulk of state-owned coal mines were closed while the most prospective mines were privatised. Due to the conflict in Donbas that started in 2014, the government lost effective control over many mines, including all anthracite producing mines. Today, only 27 state-owned mines are still controlled by the government and most of them are not profitable. This compares with 17 private mines that are economically viable and outperformed state mines with 90 % higher utilization of production capacity. The Ukrainian government plans to continue to close unprofitable mines, and an in-depth plan to do so is to be developed by September 2022.

Coal production has been declining year by year. Total coal production (including steam coal and coking coal) decreased from 164 m tons in 1990 to 31 m tons in 2019. With 89%, most of the coal was extracted by private mines, with 72% of total extraction coming from DTEK, a vertically integrated company dominating the coal mining as well as heat and power market (Table 1).

Since the early 1990s, coal production has been declining.

Table 1: Coal extraction in Mt in Ukraine

The sharp decline of coal production in 2014-15 can be attributed to the conflict in Donbas, which added to the already declining trend of the sector.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
State-owned coal mines	37.5	24.9	24.1	17.7	8.0	5.8	4.8	4.1	3.1
State share in total	46%	29%	29%	27%	20%	14%	15%	12%	11%
Private coal mines	43.6	61.1	59.6	47.3	31.8	35.1	28.2	29.1	27.7
… of which DTEK	38.4	39.4	40.0	35.0	26.7	25.7	22.9	24.1	22.4
Private share in total	54%	71%	71%	73%	80%	86%	85%	88%	89%
Total	81.1	86.0	83.7	65.0	39.7	40.9	33.0	33.3	31.2
DTEK share in total	47%	46%	48%	54%	67%	63%	69%	73%	72%

Source: MEEP (2016-2019), Razumkov Centre (2015), Kazanskyi *et al.* (2017)[1]

The main consumers of coal are the energy and the iron and steel sectors. In 2018, the energy sector consumed 27 m tonnes of steam coal while the iron and steel sector used 2.5 m tonnes of coke and 1.8 m tonnes of steam coal (Ukrstat, 2020).

The energy and iron/steel sectors are the main consumers of coal.

Due to a constant deterioration in the quality of coal since 1991, particularly in terms of sulphur content, Ukraine, formerly a net exporting country, became a net importer of coal (Oprisan, 2011). The conflict in Donbas has even increased the dependency on coal imports with Ukraine importing 22 Mt and exporting 0.09 Mt of coal in 2018 with the Russian Federation accounting for around 70% of coal imports (Ukrstat 2020).

Due to the low quality of domestic coal, Ukraine became a net importer.

Ukraine's state-owned coal mines are old, highly unprofitable and receive large subsidies to prevent their bankruptcy. Additionally, Ukrainian coal mines are among the most dangerous in the world. 1 Mt of extracted coal were paid off by 2.5 of miners' lives (ILO 2018).[2] However, it still plays a salient role as an employer in some regions. Especially in the regions Donetsk and Lugansk, a substantial share of the local working force is employed in the coal sector (Table 2). In 2019, 86,000 workers were employed in Ukrainian coal mines, equivalent to 0.5% of the total workforce in the country, 38,000 of them in state-owned and 48,000 in private mines. These figures, however, represent a loss of more than 91% of mining jobs from 1991 to 2019 (Dudău *et al.*, 2019).

Despite a lack of work safety, Ukrainian coal mines are important employers in some regions.

[1] The large drops in state production in 2012 and 2015 occurred due to the privatization of many mines in the respective year as well as the conflict in Donbas.

[2] By comparison, an average of 0.01 miners per million tonnes of coal lost their lives in US mines between 2015 and 2017 (US Department of Labor 2020; US EIA 2020).

Table 2: The economic role of the coal sector in different regions

The share of coal mining (incl. quarrying) in the economy and the share of coal workers are in particularly high in Donetsk and Dnipropetrovsk.

	Year	Ukraine overall	Donetsk region	Lugansk region	Lviv region	Volyn region	Dnipro-petrovsk
GDP per person in USD	2018	3,097	1,661	588	2,571	2,133	4,189
Share of coal sector in regional gross value added	2017	1.0%	21.8%	2.5%	6.4%	0.2%	21.6%
Total labour force working in coal sector	2019	85,529	37,659	8,018	8,438	1,414	30,000
Share of total labour force working in coal sector	2019	0.5%	5.1%	2.7%	0.8%	0.4%	2.1%
Unemployment rate	2019	8.2%	13.6%	13.7%	6.5%	10.6%	7,7%

Source: Ukrstat (2020)[3]

In international comparison, labour efficiency is very low in Ukrainian coal mines.

Labour efficiency in the Ukrainian coal sector is far behind international standards. Average labour efficiency in Poland is twice as high, in Western Europe five times as high and in the USA 20 times as high (Savitsky, 2015). While labour efficiency at private mines has increased substantially since 1991, at state-owned mines it has remained relatively low. Today, labour efficiency as tonnes of coal extracted on average by one miner is more than five times as high at private mines than at state-owned mines.

II. Coal in the electricity sector

Most thermal power plants have already exceeded their design lifetime and are far behind technical standards of the EU.

In 2019, coal has provided around 31% of Ukraine's electricity supply (IEA 2020). Electricity from coal is generated by three companies: the private companies Donbasenergo and DTEK with one and nine thermal power plants respectively, and the mostly state-owned Centroenergo, which owns three plants (Energy Community Secretariat, 2019). In Ukraine, thermal power plants are mainly fuelled with coal and only to a small extent with natural gas. Meanwhile, they are old and inefficient, with efficiency factors ranging between 0.29 and 0.34, and averaging at just 0.31. The efficiency of comparable hard coal-fuelled German plants is significantly higher at 0.39 (Agora 2019). With an average age of around 49 years most Ukrainian plants have already exceeded their technical lifetime of 40-45 years. The average load factor of Ukrainian thermal power plants is 35%, way below the EU average of 50%. A lower load factor tends to make it more difficult to achieve profitability. This is even more difficult for the operators of thermal power plants, because although prices on the Ukrainian wholesale electricity market are formed by marginal cost pricing, they are also regulated with minimum and maximum price caps.

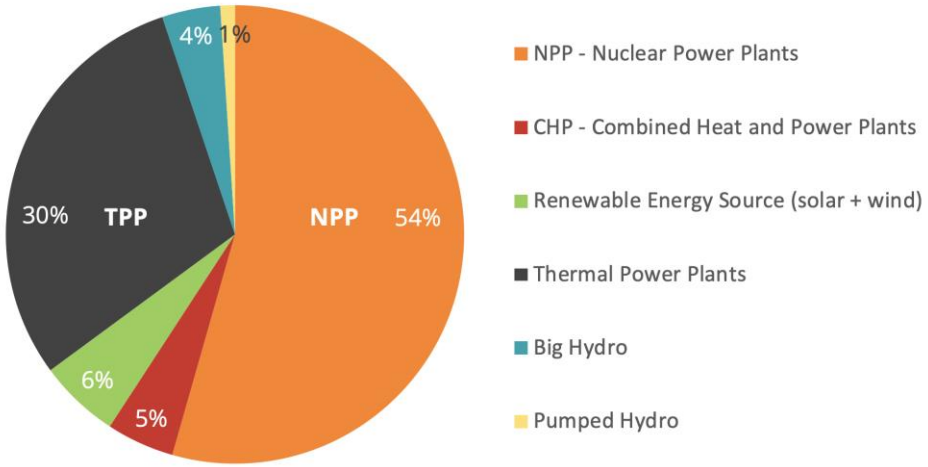
After nuclear power, coal is the second largest source of electricity generation, accounting for 55% of Ukrainian emissions.

Figure 2 shows the technology shares in electricity generation. After nuclear power, coal is the second largest source of electricity generation in Ukraine. However, the poor environmental performance and unreliability of Ukraine's depreciated coal power plants could make them unfit for competition in the EU power market after full synchronisation with ENTSO-E (OECD 2020). The electricity sector is responsible for about 50% of

[3] Official oblast statistics aggregate value-added numbers at mining and quarrying level and, up to our knowledge, it is not possible to get the figures only for coal mining. Therefore, for Dnipropetrovsk, for example, the high share of iron ore extraction is included.

Ukraine's CO2 emissions (88 of the total 183 Mt CO2). Coal is responsible for 75% of CO2 emissions in the sector, making it the main driver of greenhouse gas emissions in Ukraine (IEA 2020).

Figure 2: Technology shares in electricity generation in Q1, 2020



Source: Ukrenergo (2020)[4]

III. Expected development of coal in the electricity sector

The economic disadvantage of coal as an energy source is even enhanced through recent political developments.
The large Combustion Plants Directive requires Ukraine to lower their NOX, SO2 and dust emissions.

When Ukraine signed the Paris Agreement as one of the first countries, it committed itself to achieve net zero emissions in the second half of this century. An early coal phase-out is not only necessary for Ukraine to achieve its climate goals but will also be unavoidable for economic reasons. Coal as an energy source is losing its competitiveness against renewable energy (Lazard 2018). This economic disadvantage will soon be enhanced through recent political developments becoming effective.

When Ukraine joined the Energy Community in 2011, it committed itself to implement the Directive 2001/80/EC (Large Combustion Plants Directive). The commitment contained the regulation of emissions of large combustion plants, incl. thermal power plants and combined heat and power plants. In 2013, when it became clear that the conditions could not be fulfilled until 2018, since no progress was made, the government agreed with the Energy Community to omit compliance with these regulations and directly move to the directive with more stringent requirements – Directive 2010/75/EU (Industrial Emissions Directive). Notably, Ukraine received new, more ambitious emission standards for sulphur dioxide (SO2), nitrogen oxide (NOx) and dust under the Industrial Emissions Directive without even complying with the standards under the Large Combustion Plants Directive. Based on both directives, Ukraine adopted the National Emission Reduction Plan in November 2017. The plant contained ambitious goal, namely (1) SOX emissions reduction by factor 20 until 2028, (2) dust emissions reduction by factor 40 until 2028, and (3) NOx emissions reduction by factor 3.5 until 2033. NASU (2020) estimates that the total amount of capital investment to implement the requirements of the NERP may reach EUR 4.1 bn for the entire period until 2033.

[4] All thermal power plants in Ukraine use hard coal as a fuel, only some use additionally gas. About 32% of Ukrainian combined heat and power units use coal while the remaining units use mostly gas.

The implementation of the National Emission Reduction Plan is constantly being postponed.

In 2018, the government approved an action plan to implement National Emission Reduction Plan, but since then, no progress has been made. Due to lack of action, the Cabinet of Ministers approved amendments to the National Emission Reduction Plan already in July 2019. Currently, a postponement to the year 2038 is being discussed. Without such a law, Ukraine is currently in breach with its international obligations as a member of the European energy community, since the Industrial Emissions Directive is one of the key documents defining the acquis.

The carbon tax is likely to increase.

Secondly, the carbon tax in Ukraine is likely to increase within the next years. On the one hand this is fostered by the country's climate obligations, because a revision of the country's carbon pricing system offers great potential for its decarbonization. On the other hand, Ukraine might need to adapt its carbon price to EU levels in order to avoid negative border tax adjustment effects from the EU. We therefore propose an increase of the carbon tax from 0.33 EUR/tCO_2 to 39 EUR/tCO_2 (Breuing, 2021). This development will make it even less economical to operate coal-fired power plants.

This makes the phase out of the coal production from state and private mines economically rational.

Hence, a coal-phase out in Ukraine is necessary and economically rational. This includes not only the state-owned coal mines but also private ones as the whole sector is affected by the factors mentioned above. But with the shut-down of a whole economic sector come severe potential problems that need to be accounted for. Past mine closures in Ukraine were riddled by missing government engagement with local authorities and miners, a profound loss of social institutions connected to mining facilities, and a generally missing political will to implement recommendations by international institutions for a promising change to new economic structures (Dudău *et al.*, 2019). The think-tank ´Open Democracy´ even links the desperation of former mining communities in Eastern Ukraine to the escalation of the still ongoing conflict (Open Democracy 2016).

It would be cheaper for the country to phase out coal.

In light of these past shortcomings, and aware of the dire need to close unprofitable coal mines, we therefore propose policy measures necessary to flank a successful coal phase-out in Ukraine. All in all, a just transition - with all its expenditures - would be cheaper for Ukraine than continuing its subsidies to ill-performing coal mines.

Policy measures for the coal phase-out

The next chapter will propose policy measures for a socially and economically sustainable development path for Ukraine. A phase-out of coal subsidies could be made in order to not just reveal the unprofitability of Ukrainian coal mines, but to tap into crucial sources for financing the coal phase-out. Furthermore, we discuss policy measures aimed at miners and measures aimed at potential structural changes in coal regions.

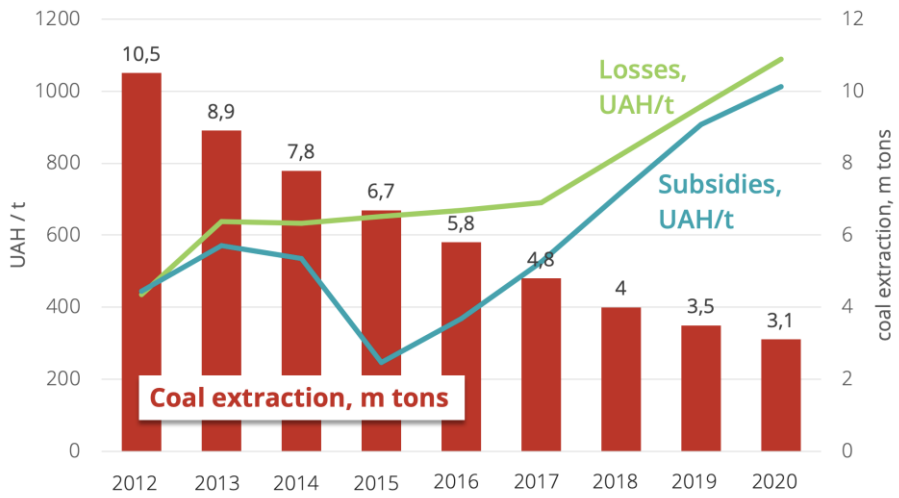
We, therefore, propose accompanying measures for a successful coal phase-out.

I. Phasing-out of subsidies

Despite stable decrease in coal production, state support per t of coal produced is increasing as illustrated in Figure 3. From 2013 to 2015 budget transfers to partially cover production costs of unprofitable state-owned coal mines decreased from UAH 536 /t to UAH 246 /t. Afterwards, however, there is a steep increase in subsidies again, exceeding pre-crisis levels. The increase in the ratio of subsidies paid per ton of coal extracted even outperforms the decrease in coal extraction, so that the total amount of fiscal support-type subsidies increased from UAH 2.0 bn (EUR 75.9 m) in 2015 to UAH 4.2 bn (EUR 145.9 m)[5] in 2019 (see Table 3 in the Annex).

Fiscal support-type subsidies per t of coal increased in recent years.

Figure 3: Coal extraction and fiscal support-type subsidies, 2012-2020



Source: MinEconEnergy (2020)

To estimate the revenue the Ukrainian government could save by phasing out producer subsidies in the coal sector, the approach from Miljevic, Mumovic and Kopac (2019) is adopted to deliver estimates for 2019. Next to fiscal support-type subsidies, as presented in Figure 3, their approach refers to the World Trade Organization definition of subsidies, i.e., it also considers public finances support subsidies and state-owned enterprise (SOE) investment support subsidies. Fiscal support-type subsidies cover direct budget transfers by the government as well as forgone government revenue. These types of subsidies directly impact the government budget. Public finance support subsidies, on the other hand, cover support (loans, grants, guarantees or equity) granted by institutions under government control or by international financial institutions. The last category, SOE investment support subsidies covers transfers of funds made by SOEs (at least 50% government owned), that cannot be justified from a pure economic or market point of view.

We add subsidies to support public finances and subsidies to encourage investment by state-owned companies to create a more complete picture of coal subsidies.

[5] Conversions are based on average exchange rate of the respective year.

In 2019, the government spent EUR 407 m on state coal mines.

Not only fiscal support-type subsidies, but also investment support subsidies increased substantially, while public finance support subsidies remained relatively constant (see Table 3 in the Annex). In 2019, the Ukrainian government spent in total EUR 407.1 m on state coal mines.

Rotterdam+ was a form of implicit subsidies.

In addition to direct subsidies, there was another form of implicit subsidies present in the sector – "Rotterdam+". "Rotterdam+" was introduced in 2016, after the loss of control over the coal-producing area in Donbas. To decrease the dependency on occupied regions and the Russian Federation, a coal-pricing formula was introduced that should allow building coal reserves from international sources and, thus, increase energy security.

Through the Rotterdam+ scheme, power producers, such as DTEK, gained profits.

Under "Rotterdam+", the price for coal was determined by the coal price index of the European coal transhipment centre in Rotterdam, taking into account the transit costs for transporting coal to Ukraine. The National Energy and Utilities Regulatory Commission (NEURC) then based the wholesale market price for electricity on this coal price. Instead of buying coal from abroad, it was still mainly sourced from Ukraine or the Russian Federation at cheaper rates. As the amount of money paid by the centralized wholesale buyer Energorynok to heat and power producers was independent of the actual coal price and solely depended on "Rotterdam+", power producers gained profits. Andrii Herus, former member of NEURC, documented that heat and power producers had a coverage of UAH 2,200/t but sourced coal for UAH 1,330/t from Ukrainian mines. The biggest beneficiary of the pricing scheme was DTEK.

The loss Induced by Rotterdam+ is estimated at around EUR 1,2 bn.

According to the anti-corruption bureau, the loss induced by "Rotterdam+" is estimated at around UAH 39.9 bn (EUR 1.2 bn) between May 2016 and June 2019 (AntAC, 2020). However, most of the costs were carried by electricity consumers due to higher wholesale prices and actual costs for the taxpayer are hard to quantify. Therefore, these implicit subsidies will be disregarded here. Additionally, with the opening of the wholesale electricity market in June 2019, "Rotterdam+" is no longer in place.

II. Labour policies

We assume a loss of 46,000 jobs in the period 2020-2030.

Ecoaction (2020) proposes to reduce the electricity share from coal to 5% until 2030. We estimate that this would imply a reduction of coal demand from the electricity sector by 80% and a reduction in the overall coal demand by 54% of the 2019 level. Assuming a proportional decrease in the number of workers in coal mining, we expect a loss of 46,000 jobs in the period 2020-2030 (see 'Estimation Method' in the Annex).

Measures aimed at coal workers are needed to accompany the reduction of coal production.

In the course of reducing coal production, accompanying measures taking care of these workers need to be an essential part of the transition strategy. Note that coal mine workers in all five oblasts are paid above average wages in the industry compared to similar jobs outside the industry. Thus, replacing the jobs without backlash from the miners is challenging.

There are three possibilities for former miners: they could be (1) occupied in the maintenance of the closed underground mines to leave it in a socially and environmentally responsible way[6], (2) retrained for another kind of job, or (3) enter early retirement.

[6] In Ukraine, most mines are underground mines which have a smaller footprint than surface mining. It is crucial to adopt sound management practices during the closure periods due to uncertainties associated with the post-closure phase and the end of economic activity (Krzemien *et al.* 2016).

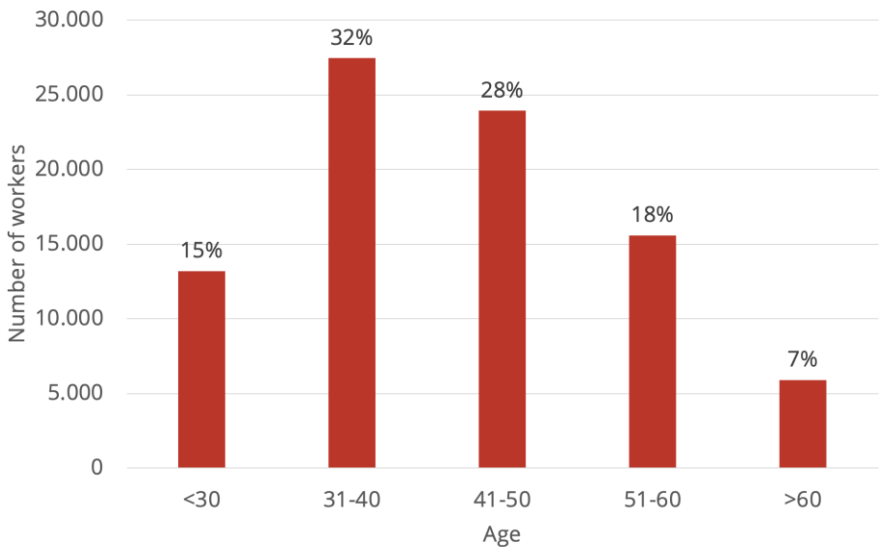
(1) The closure of the mines will require continuous support from miners. Especially the more senior miners are suitable for this job.

(2) Miners at different ages are suitable for different options. Especially younger workers should be offered attractive training programs, so they can enter jobs in renewable generation, gas power facilities or other industries.

(3) Workers with an age of up to 5 years before they would normally retire, should be incentivized to retire early by specially targeted early-retirement schemes. 22% of workers in Ukrainian coal mines are already at the age of retirement. But because the pensions are very low, they are forced to keep working. They should receive a fair pension top-up, so they do not need to work anymore (for more information on the pensions, see Table 4 in the Annex).

Options: (1) maintenance of closed mines9, (2) retraining or (3) early retirement.

Figure 4: Age structure of state mine workers



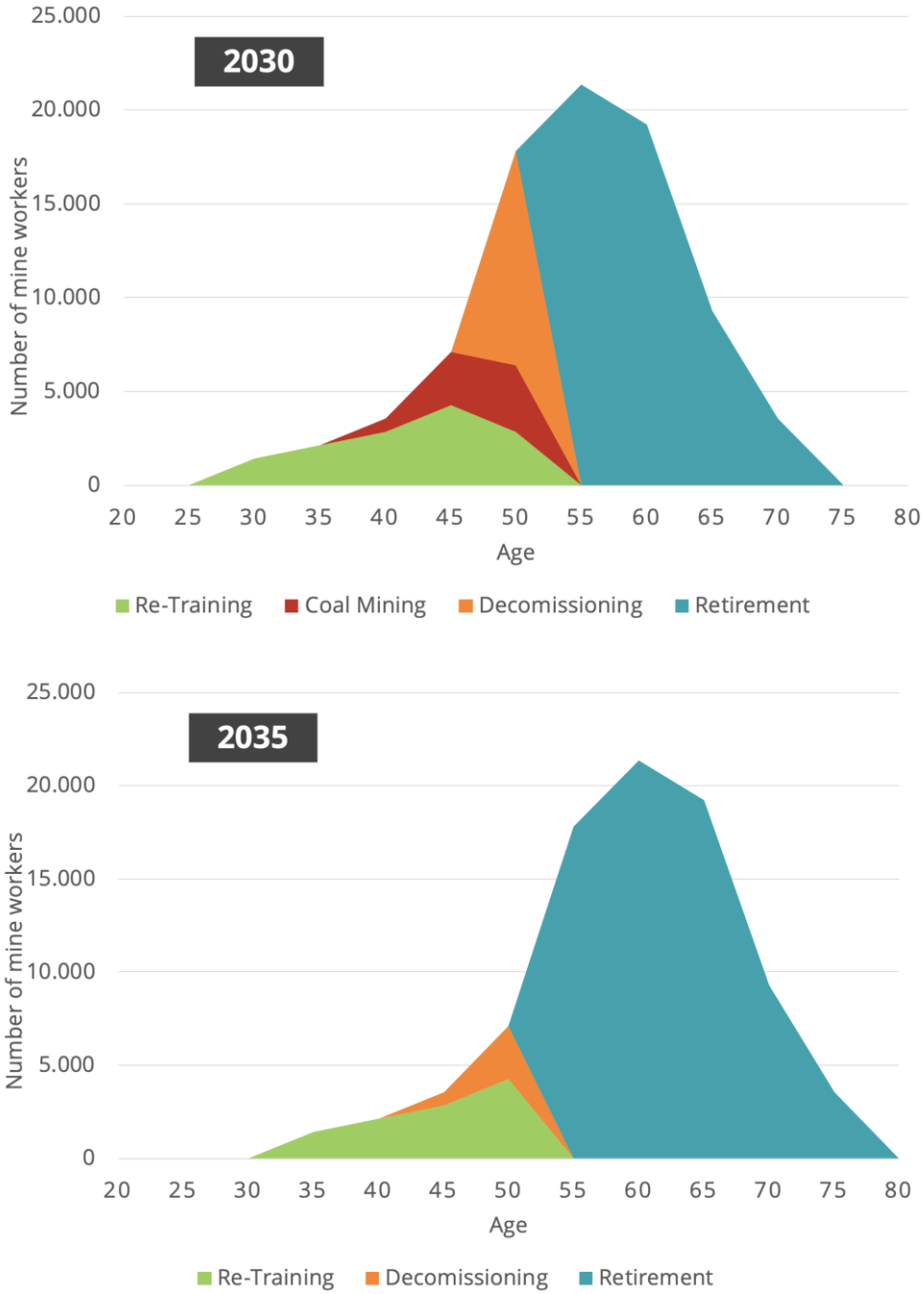
Source: Ministry of Energy and Coal Industry, as of May-2019

Figure 5 shows the exemplary distribution of the occupational activity of all 85,000 miners in the years 2030 and 2035 based on the age structure shown in Figure 4. Assuming a gradual exit from mining, only 8% of workers will be employed in mining activities in 2030, while 63% will have already reached retirement age. Young workers, about 16%, will take advantage of retraining and re-employment programs to cushion potential mass layoffs from mine closures. By 2035, most miners will have reached retirement age while the others will either be employed in the maintenance of closed mines or retrained.

Until 2030, most miners will have reached retirement age.

Figure 5: Slow phase-out of coal mining in Ukraine

Most of today's state mine workers will be on retirement in 2030, none left in mining by 2035



Source: Own estimates based on data provided by Ministry of Energy and Coal Industry, as of May-2019

Estimated costs for retraining programs sum up to around EUR 225 m until 2030.

For estimating the cost of retraining programs, we used expenditure per pupil at vocational schools in Ukraine, which amounted to EUR 1,333 in 2014 (CEDOS 2015). For the time period 2020-2030 our estimated costs sum up to around EUR 225 m. We assume that all miners that continue to work need retraining. Retraining programs should, if possible, start already before the closure of the coal mines to enable a more seamless career switch. Additionally, regional employment agencies will support the miners in finding and preparing for a new career in other economic sectors (Dudău *et al.* 2019). Due to problems in data availability, costs of early retirement programs could not be estimated.

For comparison, a study by Szabó *et al.* (2020) estimated the cost of a just transition including measures such as retraining, job matching, business start-up aid and early pensions for the countries Bulgaria, Greece and Romania. For Romania, they estimated that a just transition of around 9,100 directly affected workers in the coal sector, i.e. miners or workers in power plants, would cost around EUR 112 m. In Greece EUR 227 m would be needed due to 5,600 direct job losses. For Bulgaria EUR 220 m would be required to compensate for 14,000 direct job losses.

The costs for affected workers in a just transition ranged from EUR 112 m to EUR 227 m in GR, BG and RO.

As large shares of the miners affected by the closures are not employed by state-owned mines but private companies, it is important to create a strategy that takes both worker groups into account. Therefore, the schemes will be accessible to all miners.

All labour market policies should also be aimed at workers from private mines.

III. Structural measures

The regions that were formerly reliant and strongly influenced by the mining sector, now need support for a successful structural change and economic reorientation to build up new industries and thus, new job opportunities for the local population. These issues need to be accounted for, to avoid severe socio-economic instability in the regions. The just and comprehensive transition process needs to be organized by a set of new institutions.

New institutions need to be established to avoid socio-economic instability.

To begin with, a commission with a clear mandate representing the most important stakeholders should be established. In Ukraine, already some progress could be observed in this regard. In May 2019, a Coordination Centre for sustainable development was founded by six coal-mining cities in the Donetsk area to develop a transformation strategy for the region.[7] Today, it includes eight municipalities, three NGOs from the affected towns and the Donetsk Regional Chamber of Commerce. Furthermore, in May 2020, a national Coordination Centre for the transformation of coal regions was created under the Cabinet of Ministers including national bodies. To make this initiative more likely to succeed, it could be strengthened by making sure that all stakeholders, i.e. trade unions, local authorities, civil society and scientific institutes that could derail the process, become part of the solution and hence do not obstruct its implementation in the future. Furthermore, the Coordination Centre is lacking a clear mandate for developing a national coal transformation strategy. A permanent coal strategy working group could be mandated to develop different scenarios with international expert support to achieve this strategic goal.

A commission should be established with a clear mandate and all stakeholders in order to develop a long-term strategy.

By using the recommendations of the commission, a thorough transition strategy should be established including dates when coal shall be phased-out in energy use and how the region shall be restructured. Hereby, a bottom-up approach that takes into account the needs of the local population is essential. This strategy can be supported by regional development plans that are tailor-made to the conditions, needs and potentials of the region. As job losses and negative economic impacts are highly spatially clustered, there is a need for regional agencies in addition to the national commission. These can facilitate the participation of stakeholders, and measures can be better targeted at groups in the region.

A bottom-up approach with local stakeholders (regional agencies) is crucial for a successful just transition.

Szabó *et al.* (2020) provides cost estimates for regional development as government investment into sectors other than the coal sector to compensate for economic losses caused by a coal phase-out. For Romania, Greece and Bulgaria EUR 478 m, EUR 1,619 m and EUR 532 m respectively were estimated.

In GR, BG and RO, costs for economic development ranged from 470 m to EUR 530 m.

[7] https://www.kmu.gov.ua/en/news/minenergo-obstoyuye-kompleksnij-pidhid-do-transformaciyi-vugilnih-regioniv

For the development of the regions, Ukraine should build upon existing human capital and infrastructure.

In August 2020, Germany and Ukraine agreed to establish a German-Ukrainian energy partnership. Its aim is to intensify the collaboration between both countries in the fields of energy policy, such as the transformation of Ukrainian coal regions. During this process, a decarbonization partnership between the European Union and Ukraine could be established that would provide long-term support for financing and development of transition strategies and programmes, i.e. promoting the building of new business clusters (Heinrich Böll Foundation, 2019). They can build upon existing human capital and infrastructures aimed at new low carbon energy generation systems and other clusters of industrial development. Former coal mining sites could be reused for cultural sites to underline the regional coal-based identities, for renewable energy generation, e.g. for wind or solar parks, or they could be re-used for geothermal energy and hydropower generations (Egenhofer *et al.* 2020).

Promoting economic diversification and improving the local education system will be crucial.

An integral part of the transformation process should be the development of the local education system so that the adaption to the new labour market conditions is facilitated and the development of clusters between R&D and the industry is supported. Building modern infrastructure to connect mining regions with neighbouring cities could lead to an increase of the regions' attractivity for new emerging industries. The overall aim is to increase economic diversification in the region in order to cushion the rise in unemployment and be less vulnerable to economic shocks or sectoral downturns.

A fund for environmental damages is needed.

Lastly, a fund needs to be established that takes into account the restoration of environmental damages that occurred due to the coal mining activities (Dudău *et al.* 2019). For example, for the closure of three coal mining sites in Romania, EU state aid funds of EUR 83 m were used to finance underground safety works, surface re-cultivation and rehabilitation of the sites for the period 2016-2024.

Background info

German experience

Many former coal-mining areas in the EU have gone through transitional processes because of a coal phase-out. These coal phase-outs were accompanied by strategies designed for these regions to prevent negative effects and to enable the transition towards a successful future.

The German Ruhr region was the largest hard coal mining area in Germany which in combination with the down-stream steel industry made it an important pillar for the country's economic development in post-WWII West Germany. The highest coal output was achieved in 1957 with around 150 m tonnes of total German hard coal production in 173 mines. At the same time, the number of employees in hard coal mining peaked at around 607,000 workers from which around 500,000 were employed in the Ruhr region. From the end of the 50s, the liberalisation of coal prices made coal too costly, broke its competitiveness on the world market and put a stop on the rising German hard coal output. However, subsidies for the coal sector delayed the closure of mines so that the last two hard coal mines in the Ruhr region were closed only in 2018 when the subsidies ended. Based on the recommendations of the German Coal Commission established in 2018, Germany has committed itself to a nationwide phase-out, including lignite, in the whole country by 2035 to 2038.

During the last six decades, the Ruhr area underwent different stages of transition. In the 1950s and 60s, the strategy focused on the restoration of the industry and its workforce while also building up new alternative economic sectors.

With the industry losing its competitiveness, the latter element became more dominant over time. In the advanced process, several agencies and funds were established to take account for different needs of the transitional process: the economic development, cultural and social challenges, the environmental restoration of former industrial sites.

On top of finding solutions for the direct effects, additional projects enhanced education, innovation, infrastructure and living conditions of the region. Throughout the whole process, the integration of several stakeholders such as administrations, politicians, representatives of the civil society as well as larger and small businesses played an important role.

The strategy resulting from this bottom-up approach was therefore tailor-made to the individual needs and potentials of the region. Due to the promotion of universities and the attraction of new industries, the region's economic diversification could be increased in order to cushion the rise in unemployment. However, strong incumbent players obstructed the transformation, formed strong connections with political decision-makers and thus preserved the hard coal sector beyond economic and ecological reasons. Notably, the Ruhr hard coal phase-out took a full 60 years and Oei *et al.* (2020) argue that a faster and more pro-active hard coal mining phase-out in Germany would have been much less expensive and paved the way for new industries. (Dudău *et al.* 2019; Botta 2019)

Financing sources

A potential financing source is a gradual phase-out of state mine subsidies - EUR 1.8 bn until 2030.

To finance the measures for a just transition, there are a couple of potential financing sources. First of all, there is a potential of cross financing the measures, as a gradual phase-out of coal subsidies would save about EUR 1.8 bn over the period 2020-2030. This, for instance, could completely cover the retraining program that is estimated to cost EUR 225 m for the same period. Secondly, parts of the revenues from an increased carbon tax could serve as additional funding.

Money from the state budget for mine liquidation is mostly used to pay miners' wages.

As part of its mine closure program the Ukrainian government has earmarked money for the maintenance of closed coal mines, but this money is unlikely to be sufficient to maintain all the mines to be closed in the coming decade (Oprisan 2011). Furthermore, although the Ukrainian budget plan provided for UAH 660 m (EUR 23 m) in 2019 for the liquidation of coal mines, based on the analysis of budget transfers it can be concluded that for this reason only UAH 159 m (EUR 6 m) were used, while the majority of these funds are often spent on miners' salaries (Kornlyuk *et al.* 2020). In the first half of 2020, the government allocated UAH 3 bn (EUR 100 m) from the state budget to pay coal miners' wages.

A just transition fund is suitable to use scarce public money in a transformative way and attract private capital.

Ukraine could use its scarce financing sources in a transformative way in order to unlock potential private investment. A transition fund scheme could be established to finance the accompanying measures. To begin with, a front-loading of the fund's resources using grants will be necessary to kick-start investments. Apart from that, the fund should provide loans (incl. micro loans) and bank guarantees. The choice of instrument depends on the type of project and its development phase. E.g., a loan requires periodic servicing of interest and repayment which means that it may be more suitable for low-risk projects that generate periodic cash inflows. A competitive awarding of funding could be explored, where projects can apply by stating the amount of co-financing they need. The use of grants for the projects should always be accompanied by other financial contributions co-financing should strictly remain below 100% to ensure that the investments make sense commercially. Miners could, in parts, finance their training themselves or coal companies could carry some of the costs for retraining to employ the workers in another occupation within the company. All financing going through the Ukrainian transition fund should then reach employment-related/social projects run by public or private organisations.

Conclusion

Ukraine is facing the necessity to pursue a coal phase-out, because it is essential for the country to achieve its climate goals but also because coal loses its competitiveness as an energy source and will soon be pushed out of business. The economic disadvantage, which is reflected in a steady decline in domestic coal production and unprofitable mines, is being exacerbated by legislation such as the implementation of the National Emission Reduction Plan and a likely increase in the carbon tax.

Ukraine has to actively design a long-term strategy for the affected coal mining regions and introduce a transition plan that is accompanied and controlled by efficient policy measures. Only with a comprehensive strategy at hand mass unemployment and economic crises in the regions can be prevented.

In this paper, we propose a policy package that shall provide a basis of this strategy, offer guidelines and - where possible - some quantitative orientation of the potential costs as well as potential financing sources for the measures. This policy package consists of five different elements:

1. Phase-out coal subsidies
2. Take care of the former coal miners
3. Design comprehensive bottom-up strategies for the economic development of the regions taking into account all stakeholder
4. Create institutions guiding the transition process on both the national and local level
5. Create funds to provide grants and unlock private capital

With these measures successfully put in place, a coal phase-out will be a chance to take big steps towards decarbonization and the building of new industries for Ukraine.

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Annex

I. Additional Tables

Table 3: Subsidies for state coal mines (for all categories)

EUR m	2015	2016	2017	2018	2019
(1) FISCAL SUPPORT-TYPE SUBSIDIES	76	80	93	107	146
Restructuring of coal and peat industry (2015-17)/ Liquidation of non-profitable coal enterprises (after 2018)	8	4	8	9	4
Rescue measures at coal mining enterprises	9	9	10	9	10
State support for coal mining enterprises on partial compensation of production costs of finished marketable coal	46	48	70	33	-
Measures to improve safety measures at mining enterprises	-	-	3	-	-
Replenishment of current capital or increase the statutory funds of coal mines to settle the arrears of wages to employees as of 01-01-2015	8	18	-	-	-
State support for construction of mine №10 "Novovolynska"	6	2	2	1	2
Implementation of measures to ensure domestic coal production and further reform of the state sector of the coal industry	-	-	-	52	114
Prevention of the emergency situation due to flooding of the mines of Pervomaysko-Stakhaniv coal mining region	-	-	0	3	16
(2) PUBLIC FINANCE SUPPORT SUBSIDIES					
Loan guarantee payment from budget for Loan between Lisichanskvugillya PJSC and the State Development Bank of the PRC	16	16	15	14	14
(3) SOE INVESTMENT SUPPORT SUBSIDIES					
Taxes and contributions in arrears - state coal mines	127	147	174	239	248
Total subsidies to state coal enterprises	219	244	282	370	407

Note that one matter of expense is excluded from Table 3). Miljevic et al. (2019) add "Electricity arrears of state-owned mines to SOE 'Regional Electricity Networks'" to their list characterizing it as an indirect subsidy (see below). It is not an official subsidy like tax-related arrears but debt between the state coal mines and state electricity market operator. The characterisation as an indirect subsidy results from the fact that almost 100% would be written off after the liquidation of state coal mines. In 2018, only around 25% paid for consumed electricity since the remaining state mines suffer from a negative cash balance. However, including it to the total subsidies amount would require further analysis.

Source: Miljevic *et al.* (2017), Ministry of Finance Ukraine (2020)

Electricity arrears of state-owned mines to SOE "Regional Electricity Networks"	135	186	239	283	364

Table 4: Pensions to miners compared with other pensions in 2019

UAH m	01/2019	04/2019	07/2019	12/2019
Minimum pension (by age)	1,497	-	1,564	1,638
Average pension (by age)	2,648	2 943	-	-
Maximum pension limit	14,970	-	15,640	16,380
Minimum pension (miners)	4,491	-	4,692	4,914
Average pension (miners)	8,418	-	-	-

Source: State Pension Fund of Ukraine, Ministry of Social Policy, State Statistic Service

According to the Law "On Raising the Prestige of Miners' Work" the miners' pensions are calculated equal to 80% of earned wages (incomes) but not less than three subsistence minimums. In addition, the Ministry of Social Policy of Ukraine implemented in three consecutive rounds an increase of miners' pensions in 2014, 2015 and 2017 at the expense of the additional incomes of the Pension Fund. As of January 2017, the average miners' pension was UAH 3,926 and more than doubled to UAH 8,418 as of January 2019. Additional surcharges for occupational diseases (so called regress payments) may increase the average pension of miners up to UAH 13,000. Nevertheless, the average pension for miners can cover only average monthly living expenditures per 1 household in Donetsk region (~UAH 6,000.00 in 2018) and pose insufficient motivation for early retired miners to leave their jobs at coal mines.

Note that the reform of the pension system has to be conducted before pension schemes can be expanded. So far, Ukraine only has an ineffective and highly subsidised obligatory state-run solidarity pension system in place. The pension reform law was adopted in 2017 but the reform introducing the obligatory state-run cumulative pension system is not enacted yet as preconditions are not in place.

II. Estimation Method

Table 5: Input data of the estimation method

	2019	2030	Source
efficiency of TPPs MWh_el./MWh_therm.	0.35	0.35	Own assumption
calorific value of UA coal (MWh_therm./t)	6.92	6.92	IPCC
coal input factor, t/MWh_el	0.41	0.41	
total coal production, Mt	31.22		MEEP
emission factors, tCO_2/MWh_el	0.97	0.97	Own assumption
total electricity generation, TWh	146	198	NDC
electricity generation from coal, TWh	50.5	9.9	NDC, own assumption
Number of employees in coal mining	85,529		State Statistical Service

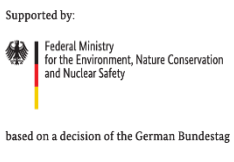
Calculations

1. Estimate total coal input from electricity generation
   coal (t) = 1/efficiency (MWh_el./MWh_therm.) * electricity generation (MWh_el.)/calorific value (MWh_therm/t)
2. Reduce coal share in electricity generation to 5%
3. Estimate coal input necessary for reduced electricity generation
4. Estimate reductions in coal production and employees in the coal sector

Table 6: Results of the estimation method

EUR m	2019	2030
coal share of total generation, %	34.6	5
coal consumption, Mt	20.9	4.09
coal consumption reduction 2030 vs. 2019, Mt		16,77
reduction share of total coal production in 2019, %		-53.72
Reduction of employees 2030 vs. 2019, absolute		45,945
Remaining employees in 2030		39,584

Implemented by



Low Carbon Ukraine is a project with the mission to continuously support the Ukrainian government with demand-driven analysis and policy proposals to promote the transition towards a low-carbon economy.

This project is part of the International Climate Initiative (IKI) and is funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) on the basis of a decision adopted by the German Bundestag. The project is implemented by BE Berlin Economics GmbH.

All results of the project are available online on www.LowCarbonUkraine.com.

We are grateful for your feedback on this Policy Proposal. Please get in touch via info@LowCarbonUkraine.com.

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